

AD-A090 194

PATH RESEARCH SAN DIEGO CA

F/G 5/9

DEVELOPMENT OF ANALYSIS, DESIGN AND DEVELOPMENT TECHNIQUES FOR --ETC(U)

JUN 80 P THURMOND

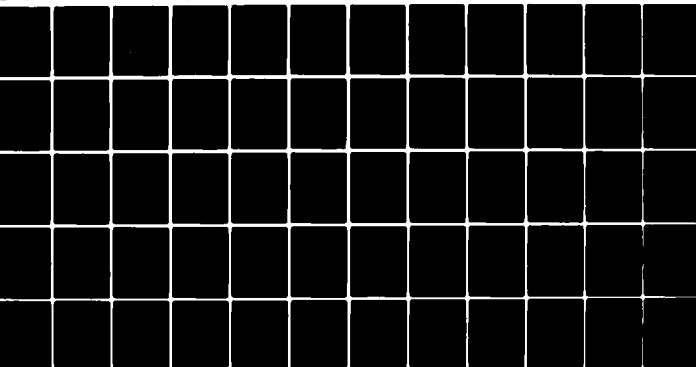
MDA903-79-C-0322

UNCLASSIFIED

PR001-80-005

NL

179
21
40



END

DATE

FORMED

41-80

DTIC

LEVEL

(12) F

AD A090194

MDA903-79-C-0322

DEVELOPMENT OF ANALYSIS, DESIGN AND DEVELOPMENT
TECHNIQUES FOR TEAM ISD

June, 1980

DTIC
OCT 6 1980
C

Prepared by
Paul Thurmond

Path Research
4250 Pacific Highway, #205
San Diego, California 92110

Prepared for
US Army Research Institute
For the Behavioral and Social Sciences
5001 Eisenhower Avenue
Alexandria, Virginia 22333

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DDC FILE COPY

The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies either express or implied, or the Army Research Institute for the Behavioral and Social Sciences of the United States Government.

80 9 29 016

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
	AD-A090194	
4. TITLE (and Subtitle)	5. TYPE OF REPORT & PERIOD COVERED	
6. Develop of Analysis, Design and Development Techniques for Team <u>ISD</u>	9. Final Report	
7. AUTHOR(s)	6. PERFORMING ORG. REPORT NUMBER	
10. Paul/Thurmond	14. PR001-80-005 NEWS	
	8. CONTRACT OR GRANT NUMBER(s)	
	15. MDA903-79-C-0322	
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
Path Research 4250 Pacific Highway, Suite 205 San Diego, CA 92110		
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE
U.S. Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue Alexandria, VA 22333		11. June 1980
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES
12. 70		63
		15. SECURITY CLASS. (of this report)
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)		
<div style="border: 1px solid black; padding: 5px; text-align: center;"> DISTRIBUTION STATEMENT A Approved for public release; Distribution Unlimited </div>		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
<div style="text-align: right;"> DTIC ELECTE OCT 6 1980 </div>		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
Collective Training Instructional Systems Development Team Training Collective Front-End Analysis		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)		
The three tasks set forth for this investigation were (1) analyze team operations and identify team structure and processes relative to the development of team training, (2) determine the applicability of the Interservice Procedures for Instructional Systems Development (ISD) to the analysis, design, and development of team instructional materials, and (3) identify appropriate procedures for the analysis, design, and development of team instructional materials.		

DD FORM 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

51C 374848

Jaw

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

The approach used to conduct this study consisted of four steps:

1. Extrapolate from the research and development literature concepts and applications that lend themselves to the specifying of collective training analysis, design and development procedures.
2. Identify procedures from the Interservice ISD model that are applicable to collective training development.
3. Review other U.S. Army and Department of Defense specifications, standards, handbooks, regulations, etc., for relevance to collective training development.
4. Interview U.S. Army training developers and collect their inputs as a basis for making recommendations for collective training analysis, design, and development documentation.

It was found that none of the ISD procedures currently employed are adequate as guidelines for team training. Critical areas where documentation is deficient include collective front-end analysis (CFEA), identification of types of team learning, and development of collective training scenarios that incorporate efficient learning principles and represent actual mission contingencies. Recommendations for improving collective training analysis, design, and development are included.

Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	<input type="checkbox"/>
on file 12 Aug 70	
By	
Distribution	
Availability Codes	
Dist	
A	

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

MDA903-79-C-0322

DEVELOPMENT OF ANALYSIS, DESIGN AND DEVELOPMENT
TECHNIQUES FOR TEAM ISD

June, 1980

Prepared by
Paul Thurmond

Path Research
4250 Pacific Highway, #205
San Diego, California 92110

Prepared for
US Army Research Institute
For the Behavioral and Social Sciences
5001 Eisenhower Avenue
Alexandria, Virginia 22333

The views, opinions, and findings contained in this report are those of the author and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation.

EXECUTIVE SUMMARY

The three tasks set forth for this investigation were (1) analyze team operations and identify team structure and processes relative to the development of team training, (2) determine the applicability of the Interservice Procedures for Instructional Systems Development (ISD) to the analysis, design, and development of team instructional materials, and (3) identify appropriate procedures for the analysis, design, and development of team instructional materials.

The approach used to conduct this study consisted of four steps:

1. Extrapolate from the research and development literature concepts and applications that lend themselves to the specifying of collective training analysis, design and development procedures.
2. Identify procedures from the Interservice ISD model that are applicable to collective training development.
3. Review other U.S. Army and Department of Defense specifications, standards, handbooks, regulations, etc., for relevance to collective training development.
4. Interview U.S. Army training developers and collect their inputs as a basis for making recommendations for collective training analysis, design, and development documentation.

It was found that none of the ISD procedures currently employed are adequate as guidelines for team training. Critical areas where documentation is deficient include collective front-end analysis (CFEA), identification of types of team learning, and development of collective training scenarios that incorporate efficient learning principles and represent actual mission contingencies. Recommendations for improving collective training analysis, design, and development are included.

CONTENTS

INTRODUCTION	1
METHODOLOGY	6
RESULTS	8
Contribution of Team Research To Collective Training Analysis, Design, and Development	8
Team Definition	8
Task Nature of Member Roles	9
Team Environment	11
Implications for Collective Training ISD	13
Application of the Interservice ISD Procedures To Collective Training	14
Summary	26
Relationship of Skill & Performance Aids (SPA) To Collective Training	26
Training Responsibilities in the SPA Life Cycle Management Model (LCSMM)	27
A Summary of the Integrated Technical Documentation and Training Development Process	30
Key SPA Guiding and Procedural Specifications, Standards, Directives, and Products	35
Assessment of Collective Front-End Analysis Procedures developed for ARTEP	43
Overview	43
Manage Analytic Process	44
Analyze Unit Mission	46
Analyze Collective Tasks	46
Assessment	47
Summary of Interviews with U.S. Army Training Developers	49
Need for Specifications for Contractor Developed Collective Training Materials	54
Need to Get Collective Training Personnel Involved in the Acquisition Process	56
CONCLUSIONS	57
RECOMMENDATIONS	59
REFERENCES	60
APPENDIX A: INTERVIEW SCENARIO	61

LIST OF ILLUSTRATIONS

Figure		Figure
1	Excerpt from Job/Task Flow Chart of Fire Mission Processed in Automatic Mode	19
2	SPA General Development Process	31
3	LSA Requirements Data	37
4	Collective Front End Analysis Model	45
5	Sample Individual/Collective Task Matrix	46

LIST OF TABLES

Table		Page
1	Summary of ISD Procedures	14
2	General Relationship of Training Activities to LCSMM Basic Events	32

INTRODUCTION

This document is the final report of a study of the "Development of Analysis, Design, and Development Techniques for Team ISD." The project was approved by the U.S. Army Research Institute for the Behavioral and Social Sciences under Contract No. MDA903-79-C-0322.

There were three tasks set forth in the contract statement of work. The tasks were:

1. Analyze team operations and identify team structure and processes relative to the development of team training.
2. Determine the applicability of the Interservice Procedures for Instructional Systems Development (as presented in TRADOC PAMPHLET 350-30) to the analyses, design, and development of team instructional materials.
3. Identify appropriate procedures for the analysis, design, and development of team instructional materials.

BACKGROUND

A central problem of achieving operational effectiveness for the military unit is determining what and how the unit of individuals is to perform collectively. The study of the relations between individuals and the general operating environment consisting of mission, threat contingencies, technology, and other individuals' behaviors has long been a focus of the human factors and psychological research communities. A considerable body of research findings has accumulated. However, when one looks at this literature, it reveals a fragmented nature - descriptive of many facets of teams and team behaviors, but it does not lend itself to be used as an analytical tool for addressing the central problem. There are no clear guidelines for specifying, in precise language, what the team's performance is to be or how the collection of individuals is to perform.

Quite the contrary is true regarding the study of the individual in an operating environment. Detailed procedures for

analyzing and designing jobs and allocating job tasks address the man-machine interface to ensure that individual capabilities are considered in the design of systems and equipment. Considerable effort has been placed on developing models and procedures for developing training materials. There is a need for providing the thorough documentation for team issues that exist for individual operations and training. This report investigates the requirement for collective training documentation. The U.S. Army Research Institute drew its focus on this requirement for collective training Instructional Systems Development (ISD) as an extension of its long range program to use tactical data systems to meet tactical training needs. The first phase of ARI's effort toward using tactical systems in an instructional mode involved the MASSTER test 122: "IBCS: Automated Instruction" project. This project demonstrated the feasibility of using a prototype tactical data processing system (DEVTOS) in a stand-alone mode to support unit training requirements.

The second phase of the ARI effort to employ tactical data systems for instructional purposes involved embedding training that was directly related to the operation of the tactical system itself. One benefit of embedded training is that it can provide training at a unit level and location thereby reducing or eliminating the need to send personnel away to school. Embedded training also accomplishes general familiarization with the tactical data system through a self-instructional mode. That is, personnel who are operators or involved in maintenance of a tactical data system are likely to have little experience with computers; thus, instructional material embedded in the tactical data system offers an additional opportunity to become familiar with system equipment and operational characteristics.

In May 1975, ARI began the development of embedded self-instructional programs for users of the TACFIRE system. The basic approach was to embed a training subsystem package within the operating TACFIRE system and to use the system itself to train personnel in its operation and maintenance. The overall aim of that effort was to extend the scope of computer-assisted instruction (CAI) to the development of self-instructional programs and

procedures for TACFIRE users. The training goals of the courseware to be used in the embedded mode were:

1. To present techniques to aid the users in learning how to operate the system,
 2. To exercise and update system related skills, and
 3. To provide on-line situational problems which enable users to exercise all the skills previously acquired.
- (SDC, 1976)

TACFIRE courseware, using the PLANIT language, was developed and produced in five functional areas. The average course time for this individualized, self-paced, embedded training program is approximately 40 hours and covers an estimated 25 to 35 percent of the Battalion Fire Direction Center operations (SDC, 1976).

A later project investigated the application of the embedded training concept to total systems operations. The objective of that project was to demonstrate and evaluate training of TACFIRE system personnel operating collectively.

The collective training was viewed as a function of the requirement for coordinated activity within the TACFIRE environment. As a computerized command/control system, TACFIRE has a number of characteristics that are common to all such systems. For example, the system is operated by teams of people whose interaction with each other in the environment are mediated by the computer complex with associated input/output requirements. Within this sophisticated and complex computer-based weapon system environment, it is essential for personnel to perform cooperatively.

A major conclusion of that effort was that an ISD model for collective training had not been defined. It was suggested that the key to developing such a model was to establish a methodology for conducting a collective job/task analysis. Until a framework existed from which to identify the specific team task dimensions characteristic of job sequences, then the systematic development of a collective training curriculum was precluded. The project

team regarded the development and implementation of team task analysis procedures as the primary problem.

STATEMENT OF THE PROBLEM

The statement of work clearly expresses the problem addressed in this study; that is, to investigate and identify procedural documentation for the analysis of collective training requirements and the design and development of collective training instructional materials. Specifically, the individual ISD procedures in TRADOC PAMPHLET 350-30 were to be reviewed to determine their applicability to a collective training ISD approach. Lastly, new approaches to collective training analysis, design, and development were to be identified for those areas where procedural deficiencies existed.

As frequently happens, the problem's characteristics and parameters evolved as the study progressed. First, as part of the Army Training and Evaluation Program (ARTEP), new documentation for conducting collective front-end analysis (CFEA) has been developed (TRADOC PAMPHLET 310-8 (Draft)). Certainly, the procedures identified in this pamphlet should be incorporated in the study.

Second, the increasing emphasis by the Army on Skills Performance Aids (SPA) led us to review the SPA (an outgrowth of the Integrated Technical Documentation and Training (ITDT) program) documentation, particularly the front-end analysis procedures, for applicability to collective training.

The following questions were formulated to represent all of the major facets of the problem:

1. What principles and concepts, extracted from team research literature, provide a basis for the analysis, design, and development of collective training?
2. Are the ISD procedures set forth in TRADOC PAMPHLET 350-30 sufficient guidelines for collective training ISD?
3. Has the introduction of Skills Performance Aids as the integration of technical documentation and training provided a basis or guidelines for developing collective training materials?

4. Do the Collective Front-End Analysis techniques contained in TRADOC PAMPHLET 310-8 (Draft) provide sufficient detail to the collective training developer?
5. What aspects of collective training analysis, design, and development continue to present problems to the collective training developer?
6. How may remaining collective training analysis, design, and development problems be resolved?

Each of these questions is addressed in the following sections of this document. Questions 1 through 4 are answered in the RESULTS section. Question 5 provides the context for the CONCLUSIONS. Question 6 is addressed in the RECOMMENDATIONS.

METHODOLOGY

The approach used to conduct this study consisted of four steps:

1. Extrapolate from the research and development literature concepts and applications that lend themselves to the specifying of collective training analysis, design and development procedures.
2. Identify procedures from the Interservice ISD model that are applicable to collective training development.
3. Review other U.S. Army and Department of Defense specifications, standards, handbooks, regulations, etc., for relevance to collective training development.
4. Interview U.S. Army training developers and collect their inputs as a basis for making recommendations for collective training analysis, design, and development documentation.

Step one did not require that a comprehensive review of the R & D literature be conducted. That task had been performed and reported in two prior projects, and many of the major contributors to the field were identified. The work of these researchers was reviewed. An update check of the literature was performed via ERIC and Defense Documentation Center searches.

Steps two and three involved analyzing existing documentation. This analysis effort consisted of identifying the inputs and outputs of related procedural guidelines and defining the processes that comprised the particular function being investigated. This was true whether the material dealt with individual training, front-end analysis (FEA) or logistic support analysis (LSA). The purpose was to those information sources and documentation that could either (1) be interfaced with collective training development, or (2) provide insights or perhaps serve as a model of the development of collective training analysis, design, or development guidelines.

The fourth step was to interview 12 training developers from the U.S. Army Field Artillery School (USAFAS) at Fort Sill, Oklahoma. The purpose of the interviews was threefold. First, the interview formats were designed so that the collective training practices being used at USAFAS could be defined while at the same time maintaining the context of the individual ISD model. This rigid format was employed because we hoped to retain as much of the individual ISD model's proceduralization as possible if, in fact, it was useful to collective training developers. The second purpose of the interviews was to identify the problems encountered by the collective training developers. Third, the interviews were used to collect the recommendations of the training developers in regard to the analysis, design, and development of collective training.

The following sections are the products of the data collection and analysis performed in the four steps described.

RESULTS

As stated earlier, this section provides responses to questions 1 through 4 as formulated in the Statement of the Problem. These questions were as follows:

1. What principles and concepts, extracted from team research literature, provide a basis for the analysis, design and development of collective training?
2. Are the ISD procedures set forth in TRADOC PAMPHLET 350-30 sufficient guidelines for collective training ISD?
3. Has the introduction of Skills Performance Aids as the integration of technical documentation and training provided a basis or guidelines for developing collective training materials?
4. Do the Collective Front-End Analysis techniques contained in TRADOC PAMPHLET 310-8 (Draft) provide sufficient detail to the collective training developer?

Additionally, the RESULTS section contains a summary of the interviews that were conducted with the personnel at Fort Sill.

CONTRIBUTION OF TEAM RESEARCH TO COLLECTIVE TRAINING ANALYSIS, DESIGN, AND DEVELOPMENT

Task 1 called for the analysis of team operation and the identification of team attributes relative to the development of collective training. This analysis was performed on the basis of a review of literature. A detailed discussion of the findings is contained in the interim report for this project. However, it is worthy to iterate the major findings and conclusions reached.

Team Definition:

The first item that was addressed was the establishment of a working definition of a team. The definition needed not to go beyond the military utilization of multi-individual working groups. The definition that was accepted was set forth by Klaus and Glaser

(1968) and utilized in an earlier team training study sponsored by ARI (Thurmond and Kribs, 1977). The definition of a team was as follows:

The team is usually well organized, highly structured, and has relatively formal operating procedures - as exemplified by a baseball team, an aircraft crew, or ship control team. Teams generally:

- (1) Are relatively rigid in a structure, organization and communication networks,
- (2) Have well-defined positions or numbers assignments so that participation in a given task by each individual can be anticipated to a given extent,
- (3) Depend on the cooperative or coordinative participation of several specialized individuals whose activities contain a little overlap and who must each perform their task at least at some minimum level of proficiency,
- (4) Are often involved with equipment or tasks requiring perceptual motor activities, and
- (5) Can be given specific guidance on job performance based on a task analysis of the team's equipment, mission or situation.

Task Nature of Member Roles:

A problem related to defining the team is that team composition (man and machine) and member roles change according to team missions and tasks. An example of this situation is the TACFIRE team normally consisting of a Communications Operator (Comm. Op.), Fire Direction Sergeant (FDS), and Fire Direction Officer (FDO). In many cases, external inputs should not be considered as an enlargement of team size, but during a fire mission the external observer is as integrated into the team operation as any other member. Thus, while we defined teams as having a rigid structure with fixed organizational and communication networks, from a

practical point of view, there must be allowances for flexibility given the variety of tasks performed by the team.

This definition also allows for the close analogy that can be made between team and individual performance. Skilled activity in an individual means that the individual's response meets certain requirements of timing, coordination, and sensitivity to environmental changes. Skilled activity by a team means meeting the same requirements. (Glanzer, 1961.) That is, team skills can only be defined within the context of the environment and the mission. Thus, as these functions change, so must the team adapt.

Due to this similarity between individual and teams, Glanzer further argued that several general principles of learning that are applicable to individual training also are applicable to team training. These principles include:

Immediate Feedback or Reinforcement. Knowledge of results (KOR) should be as fast as possible.

Simulation. The training situation should be as similar as possible to the working environment.

Representativeness. The training should sample the total task range of the working environment.

Statement and Incorporation of Requirements. Job performance measures and criteria should be explicitly stated and incorporated in the training environment.

Principles of Learning. There are a number of learning principles whose relevance to the training environment should be considered. These include the distribution and massing of practice and the use of previously learned behavior.

In the analysis of teams for training purposes, it is important that the ISD designer not only consider the structural definition of the team and the general principles applicable to its training, but also identify the functions that are set forth as the purpose of team tasks and behavior. This analysis should lead to a clear statement of the team mission and submissions (specific jobs such

as fire planning, fire missions etc.). It is important to structure the jobs of the team in order to more precisely determine the team organization and task sequences necessary to the accomplishment of the mission. Further, the ISD analyst's primary responsibility is to relate team performance to the fulfillment of functional requirements. To improve team performance means to more efficiently or effectively fulfill the functional requirements.

Team Environment:

Another important concept in defining team training requirements is determining the operating situations in which a team may have to perform. Boguslaw and Porter (1963) discuss the operating environment as a continuum, the end points of which are described as established or emergent. They define these situations as follows:

An established situation is one in which (1) all action-relevant environmental conditions are specifiable and predictable, (2) all action-relevant states of the system are specifiable and predictable, and (3) available research technology or records are adequate to provide statements about the probable consequences of alternative actions. An emergent situation is one in which (1) all action-relevant environmental conditions have not been specified, (2) the state of the system does not correspond to relied upon predictions, and (3) analytical solutions are not available given current states of analytical technology.

The two conceptual viewpoints have also served as contexts for team training research. For example, investigation of team member interactions in an established situation was a primary focus of a team training laboratory program at the American Institute of Research (Klaus and Glaser, 1960). There are obvious advantages to the team training laboratory research, but the often necessary simplification of the team functions can mask or omit possible important variables which influence behavior in the real world.

Abstracting the situational contexts in the laboratory can result in a loss of opportunity for trainees to react to breakdowns or problems which may arise in an operational setting (Wagner, et al., 1976).

Providing skills to deal with emergent unstructured situations was seen as a major goal of a System Development Corporation team training program for the Air Force (Alexander and Cooperband, 1965). The development of coordination skills was stressed although it was recognized that these are based upon attainment of minimum individual skills. In turn, team training devices and techniques were seen as requiring orientation for training innovative behaviors and skills necessary to adapt to unforeseen problems. It was agreed that emergent situation training permits a more realistic, less abstract approach than established situation training. In the emergent case, what seems to be important is training team members to become fully aware of their responsibilities, to compensate for the inability of others, and to overcome temporary problems when the situation calls for it.

Thurmond and Kribs (1977) applied the concept of the situational continuum to the development of a team job/task analysis technique. Using this technique, the standard operating procedural (SOP) task flow was established for a variety of fire mission jobs performed by a battalion level fire director control team. Once the SOP flow was determined, the interviews were conducted with experienced team members in order to discuss (1) the emergent situational factors which impacted the SOP, and (2) errors that led to malfunctions in the team operations.

It is obvious that in actuality, no team operates in purely an established or an emergent situation. Therefore, in conducting the job/task and training analysis, emphasis was placed first on defining the precise TACFIRE established situation as prescribed by standard operating procedures and, secondly, on identifying the most common and critical emergent situations that impact actual operations of the TACFIRE system. By defining both the established and the emergent situations, the team member interactions which

occur in both cases could be analyzed in order to determine the team task dimensions that are present.

Implications for Collective Training ISD:

Although the research literature did not focus on the problem of designing and developing collective training, some very clear guidelines emerged. Those include:

1. Team behavior must be analyzed within the context of its purpose or mission.
2. Individual job/tasks performance requirements change according to mission; therefore, there should be a process for identifying the specific individual job/tasks associated with a particular mission.
3. Collective and individual performances occur along a continuum of environmental conditions ranging from static to highly dynamic. Training should reflect this range of conditions via instructional strategies related to the scope and sequencing of instruction.
4. There are a number of basic principles of learning that apply to both individual and collective training.

APPLICATION OF THE INTERSERVICE ISD PROCEDURES TO COLLECTIVE TRAINING

This section represents the results of Task 2. These results were discussed in the interim report; however, a review of these results is in order.

Each step or function comprising the Analysis, Design and Development phases of the ISD model, as summarized in Table 1, is discussed in terms of (1) the adequacy or inadequacy of the procedures when applied to collective training, and (2) potential methods that might be more applicable. Additionally, the model was reviewed in order to determine if the guidelines that emerged from the research literature were incorporated. Of the 14 major functions, seven were identified as being both critical to collective training development and as not being applicable in their individually-oriented form. These included the following functions:

1. Analyze Job
2. Construct Job Performance Measures
3. Select Instructional Setting
4. Develop Objectives
5. Develop Tests
6. Describe Entry Behavior
7. Determine Scope and Sequence.

Analyze Job - The job analysis is the singularly most important aspect of the ISD effort. From the Task and Skills Analysis (TASA) of the job spring all other instructional design parameters. The procedures set forth in TRADOC PAMPHLET 350-30 provide considerable detail regarding job analysis procedures and outputs. Task analysis worksheets are discussed and examples illustrated.

Task analysis has also been identified as the heart of team training (Thurmond and Kribs, 1977). However, the procedures and worksheets presented in TRADOC PAMPHLET 350-30 are not sufficient for defining team operations. The team job/task analysis must cover both standard operating procedures and emergent phenomena that impact the team's functioning. Alexander and Cooperband (1965)

TABLE 1. SUMMARY OF ISD PROCEDURES

PHASE 1 ANALYZE - PRESENTS PROCEDURES FOR DEFINING WHAT JOBS ARE, BREAKING THESE DOWN INTO STATEMENTS OF TASKS, AND USING NUMERICAL TECHNIQUES TO COMBINE THE BEST JUDGEMENT OF EXPERIENCED PROFESSIONALS TO SELECT TASKS FOR TRAINING. PHASE 1 ALSO PRESENTS PROCESSES FOR CONSTRUCTION OF JOB PERFORMANCE MEASURES AND THE SHARING OF OCCUPATIONAL AND TRAINING INFORMATION WITHIN AND AMONG THE SERVICES. IT PROVIDES A RATIONALE FOR DECIDING WHETHER TASK SHOULD BE TRAINED IN SCHOOLS, ON THE JOB, OR ELSEWHERE, AND ALSO REQUIRES CONSIDERATION OF THE INTERACTION BETWEEN TRAINING AND CAREER PROGRESSION.					
FUNCTION	PURPOSE	METHODS	INPUTS	PROCEDURES	OUTPUTS
1.1 ANALYZE JOB	IDENTIFY WHAT PEOPLE DO IN THEIR JOB, THE ORDER IN WHICH THEY DO IT, THE CONDITIONS, AND THE LEVEL OF SKILL OR PERFORMANCE DEEMED ADEQUATE.	1. INCIDENT OBSERVATION 2. INCUMBENT INTERVIEW 3. OCCUPATIONAL SURVEY	1. NEEDS ANALYSIS 2. NEW WEAPON SYSTEMS/EQUIPMENT INSTALLATION 3. UPDATING OF DOS'S	1. DEVELOP TENTATIVE TASK LIST 2. AUTHENTICATE TASK LIST 3. VALIDATE TASK LIST 4. COLLECT TASK CONDITIONS, TASK CUES, TASK STANDARDS	1. VALIDATED TASK LIST WITH CONDITIONS, CUES, AND STANDARDS WITH DOCUMENTATION OF THE TASK ELEMENTS
1.2 SELECT TASKS/FUNCTIONS	SELECT TASKS FOR WHICH TRAINING WILL BE DEVELOPED AND/OR CONDUCTED	1. ESTABLISHED PRIORITIZATION SCHEMES	1. OUTPUTS OF TASK 1.1	1. IDENTIFY CRITERIA FOR SELECTING A. % PERFORMANCE B. % TIME SPENT PERFORMING C. CONSEQUENCES OF INADEQUATE PERFORMANCE D. TASK DELAY TOLERANCE E. FREQUENCY OF PERFORMANCE F. TASK LEARNING DIFFICULTY G. PROBABILITY OF DEFICIENT PERFORMANCE H. IMMEDIACY OF PERFORMANCE 2. ORGANIZE TASKS TRNG-NON-TRNG 3. RECOMMENDATIONS	1. LIST OF TASK SELECTED FOR TRAINING BASED ON RESOURCE AVAILABILITY 2. DETERMINATION OF RESOURCES 3. APPROVALS/ APPROVAL
1.3 CONSTRUCT PERFORMANCE MEASURES	TO IDENTIFY FOR EACH TASK SELECTED FOR TRAINING	1. ANALYTICAL 2. HISTORICAL DATA 3. OPERATIONAL DEFINITIONS	1. OUTPUTS OF TASK 1.2	1. SIMULATION ANALYSIS 2. EST. LEVEL OF FIDELITY 3. ANALYZE TIME & COST 4. SELECT PRODUCT, PROCESS AND/OR A COMBINATION 5. DEVELOP JPM 6. VALIDATE IN THE FIELD	1. JPM'S 2. REC. FOR SIMULATORS 3. DIRECTIONS AND SCORING KEY
1.4 ANALYZE EXISTING COURSES	AVOID UNNECESSARY DUPLICATION	1. TASK TAUGHT COMPARISON	1. OUTPUTS OF TASK 1.1, 1.2 & 1.3	1. IDENTIFY COURSES 2. ANALYZE FOR TASK & JPM SIMILARITIES 3. CK. FOR COURSE VALIDATION	1. ACCEPT/REJECT EXISTING TRAINING
1.5 SELECT INSTRUCTIONAL SETTING	TO ASSIGN INSTRUCTIONAL TASK TO 1 OF THE FOLLOWING 5 SETTINGS 1. JPA 2. SELF-TEACHING PACKAGES 3. FORMAL OJT 4. INSTALLATION SUPPORT SCHOOLS 5. RESIDENT SCHOOLS	1. ESTABLISHED GUIDELINES 2. TRADE-OFFS	1. ALL DOCUMENTATION FROM 1.1, 1.2, 1.3 & 1.4	1. CLUSTER TASKS BY SKILLS 2. CLUSTER BY FRAG. CONSTRAINTS 3. APPLY SETTING SELECTION LOGIC	1. LIST OF TASKS WITH ASSIGNED INSTRUCTIONAL SETTING 2. DOCUMENTATION AND RATIONALE
					1. RESOURCE, COSTS & COORDINATION BASED DECISIONS

TABLE I. SUMMARY OF ISD PROCEDURES

PHASE II DESIGN		DEALS SPECIFICALLY WITH THE DESIGN ASPECT OF THE TRAINING PROGRAM WITHIN SELECTED SETTINGS. DESIGN HERE IS CONSIDERED IN THE ARCHITECTURAL SENSE IN WHICH THE FORM AND SPECIFICATIONS FOR TRAINING ARE LAID DOWN IN CAREFUL DETAIL. PHASE II REVIEWS THE CONSIDERATIONS RELATING TO ENTRY BEHAVIOR OF TWO SEPARATE KINDS: GENERAL ABILITY AND PRIOR EXPERIENCE. A RATIONALE IS PRESENTED FOR ESTABLISHING REQUIREMENTS BASED ON THE REALISTIC EVALUATION OF BOTH OF THESE FACTORS.						
FUNCTION	PURPOSE	METHODS	INPUTS	PROCEDURES	OUTPUTS	MANAGEMENT DECISIONS/ACTIONS		
II.1 DEVELOP OBJECTIVES	1. DEVELOP LEARNING OBJECTIVES FOR EACH SELECTED TRAINING TASK. LEARNING OBJECTIVES COVER 4 CATEGORIES: A. INFORMATION B. MENTAL SKILLS C. PHYSICAL SKILLS D. ATTITUDES	1. STANDARD PROCEDURES	1. TOTAL OUTPUT OF PHASE I	1. PREPARE TERMINAL LEARNING OBJECTIVES WITH ACTIONS, STANDARDS, & CONDITIONS 2. ANALYZE OBJECTIVES FOR PREREQUISITE SKILLS 3. CONDUCT LEARNING ANALYSIS	1. TERMINAL LEARNING OBJECTIVES	1. IDENTIFY RELATIONSHIP BETWEEN TERMINAL OBJECTIVE & JPM		
II.2 DEVELOP TESTS	DEVELOP INSTRUMENTS/PROCEDURES THAT MEASURE THE OUTCOMES OF INSTRUCTION	1. STANDARD PROCEDURES	1. JPM'S (I,3) 2. SETTING SELECTION (I,5) 3. LEARNING OBJECTIVES (II.1)	1. SELECT TEST TYPE TO BE DEVELOPED 2. VERIFY ITEMS 3. REVISE AS REQUIRED	1. ITEMS FOR ENTRY TEST 2. ITEMS FOR PRETEST 3. ITEMS FOR WITHIN COURSE TEST	1. DETERMINE FIDELITY OF TEST SETTING, COMPLETENESS AND THOROUGHNESS OF TEST, AND THE USE OF THE TEST IN ESTABLISHING BASELINES		
II.3 DESCRIBE ENTRY BEHAVIORS	IDENTIFY (1) BASIC ATTITUDES AND ABILITIES AND (2) ACQUIRED KNOWLEDGE AND SKILLS	1. HISTORICAL DATA 2. TEST DESIGN	1. OUTPUTS OF II.1 2. OUTPUTS OF II.2 3. ADMINISTRATIVE CRITERIA FROM PERSONNEL SYSTEM	1. DEVELOP AN ENTRY TEST 2. TEST TRIALS TO VERIFY ASSUMPTIONS MADE ON ENTRY CHARACTERISTICS 3. MAKE REVISIONS	1. DESCRIPTION OF ENTRY 2. ENTRY TEST 3. PRETESTS 4. REVISED LEARNING OBJECTIVES AND TEST WHICH MATCH THE VERIFIED ENTRY BEHAVIOR	1. MATCH INSTRUCTION WITH ENTRY BEHAVIOR.		
II.4 DETERMINE SEQUENCE & STRUCTURE	IDENTIFY TERMINAL LEARNING OBJECTIVES [TLO'S], LEARNING STEPS [LS'S] WHICH HAVE INDEPENDENT, DEPENDENT, AND/OR SUPPORTIVE RELATIONSHIPS	1. ANALYTICAL	1. OUTPUTS OF II.1, II.2, II.3	1. CONDUCT LEARNING ANALYSIS AS WAS PERFORMED IN BLOCK II.1	1. CLASSIFICATION OF OBJECTIVES	1. REVIEW & APPROVE		

TABLE 1. SUMMARY OF ISD PROCEDURES

PHASE III DEVELOP		REFERS TO THE PREPARATION OF INSTRUCTION. DETERMINATIONS ARE MADE ABOUT HOW THE STUDENTS SHALL BE MANAGED, THE KINDS OF LEARNING EXPERIENCES THEY WILL HAVE, THE ACTIVITIES IN WHICH THEY WILL ENGAGE, AND THE FORM AND CONTENT OF THE INSTRUCTIONAL DELIVERY SYSTEM. TECHNIQUES ARE PRESENTED FOR THE CAREFUL REVIEW AND ADAPTATION OF EXISTING MATERIALS. PROCEDURES FOR THE SYSTEMATIC DESIGN OF INSTRUCTION WHICH CAN BE DELIVERED IN A VARIETY OF MEDIA ARE ALSO INCLUDED. PHASE III TERMINATE WITH A CAREFULLY DEVELOPED PROCEDURE FOR TESTING AND EVALUATING THE INSTRUCTION TO INSURE THAT ITS PERFORMANCE MEETS EXPECTATIONS.				
FUNCTION	PURPOSE	METHODS	INPUTS	PROCEDURES	OUTPUTS	MANAGEMENT DECISIONS/ACTIONS
III.1 SPECIFY LEARNING EVENTS/ ACTIVITIES	TO CLASSIFY THE LEARNING OBJECTIVES INTO APPROPRIATE CATEGORIES AND TO IDENTIFY THE LEARNING GUIDELINES NECESSARY FOR OPTIMUM LEARNING TO TAKE PLACE	1. APPLICATION OF LEARNING GUIDELINES 2. TESTS (II.1) 3. ENTRY BEHAVIOR SPEC. (II.2) 4. SEQUENCE & STRUCTURE OF OBJECTIVES (II.4) 5. ALL OUTPUTS OF PHASE I	1. LEARNING OBJECTIVES (II.1) 2. TESTS (II.2) 3. ENTRY BEHAVIOR SPEC. (II.3) 4. SEQUENCE & STRUCTURE OF OBJECTIVES (II.4) 5. ALL OUTPUTS OF PHASE I	APPLICATION OF LEARNING GUIDELINES	1. THE CLASSIFICATION OF LO'S 2. LEARNING GUIDELINES FOR CLUSTERS OF LO'S 3. SELECTED LEARNING EVENTS	1. REVIEW AND APPROVAL
III.2 SPECIFY INSTR. MANAGE- MENT PLAN AND DELIVERY SYSTEM	TO DETERMINE HOW THE INSTRUCTION IS TO BE PRESENTED TO THE STUDENT AND TO PREPARE SYSTEM MGMT. PLAN	1. APPLICATION OF MEDIA SELECTION GUIDELINES	1. LEARNING EVENTS AND ACTIVITIES (III.1) 2. SETTING SELECTION CRITERIA AND RATIONALE (I.8) 3. EXISTING COURSE INFORMATION (I.4)	APPLICATION OF MEDIA SELECTION GUIDELINES. PLANNING COURSE MANAGEMENT.	1. SYSTEM MASTER PLAN 2. SELECTED MEDIA AND ALTERNATIVES	1. MEDIA SELECTION 2. RESOURCE ALLOCATION 3. COURSE PARAMETERS
III.3 REVIEW/ SELECT EXISTING MATERIALS	TO DETERMINE POTENTIAL VALUE OF EXISTING MATERIALS TO MEET LEARNING OBJECTIVES	1. ANALYSIS OF EXISTING TRAINING MATERIALS	1. LEARNING EVENTS AND ACTIVITIES (III.1) 2. OUTPUTS OF III.2 3. STUDENT ENTRY BEHAVIORS (II.3) 4. CANDIDATE EXISTING COURSES (I.4)	MATCH COURSE CHARACTERISTICS WITH LEARNING OBJECTIVES AND CONDITIONS AND STANDARDS	1. LIST OF EXISTING MATERIALS TO BE USED 2. RECOMMENDATIONS FOR MODIFYING EXISTING MATERIALS	1. TRADE-OFFS EXISTING VS. MODIFIED EXISTING VS. NEW MATERIALS
III.4 DEVELOP INSTRU- CTION	TO PRODUCE THE REQUIRED INSTRUCTIONAL MATERIALS	1. JAW WITH ISD PRODUCTION STANDARDS, SYSTEM MASTER PLAN, AND QA REQUIREMENTS	1. ALL AVAILABLE DOCUMENTATION	PRODUCE MATERIALS	1. ALL MATERIALS, PROCEDURES, PLANS AND MEDIA	1. COORDINATE WORK EFFORT
III.5 VALIDATE INSTRU- CTION	TO DETERMINE AND ENSURE EFFECTIVENESS OF INSTRUCTIONAL MATERIALS.	1. EMPIRICAL TESTING	1. INSTRUCTIONAL MATERIAL (II.4) 2. TEST (II.2)	INDIVIDUAL AND GROUP TESTING.	1. VALIDATED MATERIALS	1. ACCEPT - REJECT

saw the providing of skills to deal with emergent instructional situations as the most important function of team training.

A team job/task and training analysis was conducted for the TACFIRE battalion level Fire Direction Control Team (Thurmond and Kribs, 1977). The methodology employed was a modification of work conducted by Folley (1964) and Klaus and Glaser (1960).

This analysis included a description of each act carried out by team members and the sequencing of the acts. Every act of team members was broken down into three elements: input, the signal or stimuli that elicits the behavior; process, the response; and output, the signals or stimuli resulting from the process. Each act was then linked to subsequent acts as either a man-man interaction or a man-computer-man interaction. In this way it was possible to set up a team task flow for the established situation.

The man-machine-man interaction was representative of two types of machines, the radio and the computer, and for two types of machine mediation. The first type of machine mediation requires only that the machine be a vehicle for transmitting data from one point to another. The radio always performs this type of function, the computer frequently does. The second type of machine mediation requires that the machine perform a function which before its introduction was performed by man or a different, and probably a less sophisticated, machine. The function may be, for example, a calculation, record keeping, a check of procedures, or even the making of a decision. Only the computer, with its associated peripherals, can perform these functions. Thus, in the Job/Task Flow Charts, the types of system programs used for data analysis and manipulation by the computer are identified as well as if the machine mediation is solely for the data transmittal.

Figure 1 illustrates the team task flow for a segment of a fire mission conducted by the FDC team in an automated mode. As can be seen, the approach combines traditional task analysis techniques with the operations research technique of developing operational sequence diagrams (OSD) in defining the standard operating procedure for a particular team mission.

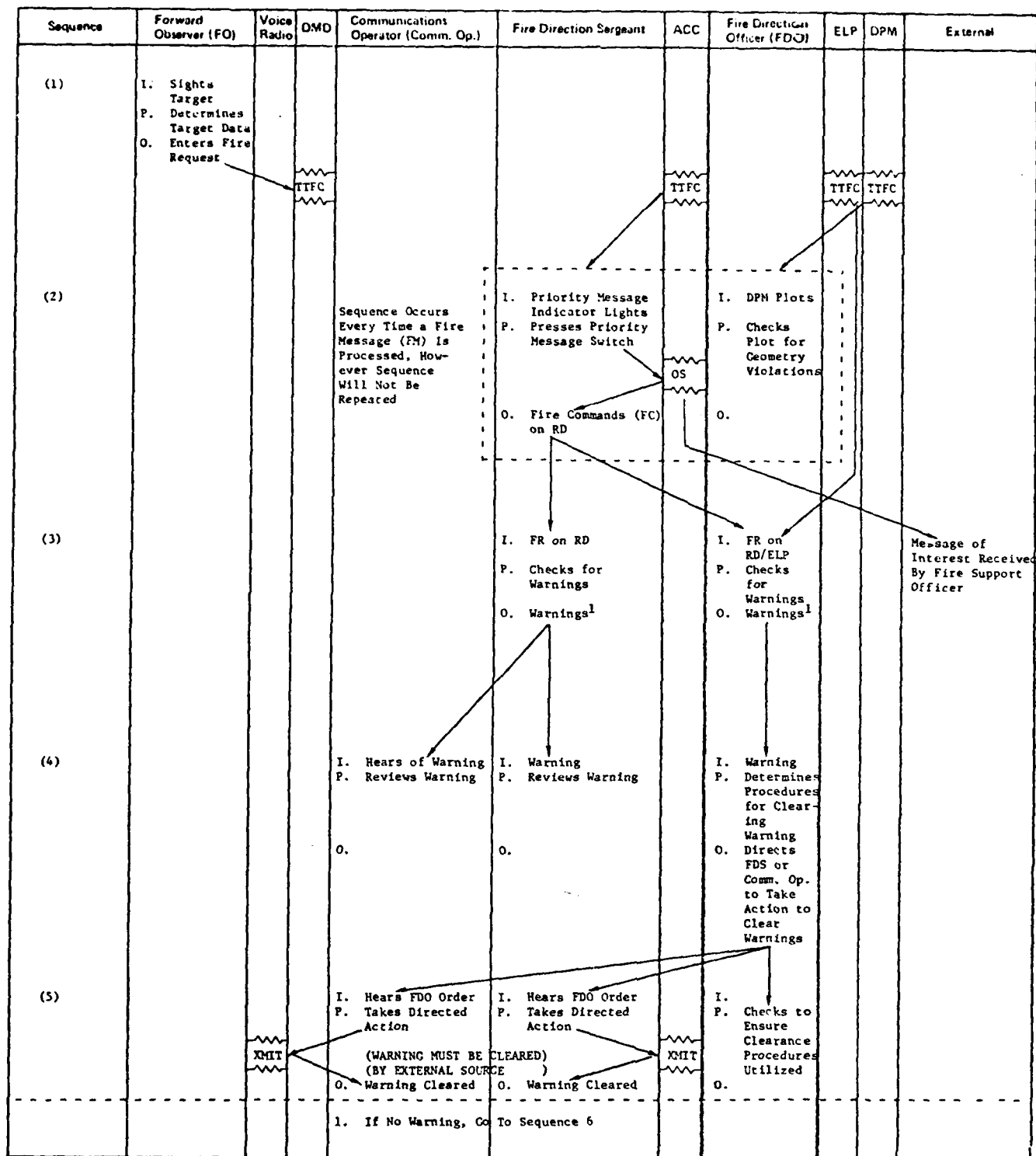


Figure 1

Excerpt from Job/Task Flow Chart of Fire Mission Processed in Automatic Mode.

The second phase of the team job/task analysis was to identify emergent situations at each point of team member action and interaction. Emergent factors included (1) individual errors (both errors of commission and omission were identified, (2) machine failures, and (3) contingent environmental conditions (ranging upwards to catastrophes). Individual errors were further analyzed to determine the impact on the total team operation and to determine how they could be mitigated via team training.

Construct Job Performance Measures - Job Performance Measures (JPM) are constructed for each task identified during the job/task and training analyses. The JPM is a precise, quantitatively-based statement of what is expected in job performance and how best to measure an individual realization of that performance. In many cases, the JPM will in fact be performance of the task. In other cases, where time, costs, safety and other such factors mitigate, the actual task cannot be performed. In such instances, the ISD designer must develop test conditions and standards, the results from which will predict job performance. In the latter case, consideration must be given to the need for simulators or other factors which may effect the level of fidelity built into the JPM. A high fidelity JPM is one that closely resembles the actions, conditions, cues, and standards actually performed on the job.

The guidelines for developing JPMS for individually oriented tasks are complete; however, no techniques for establishing team and team member performance measures have been developed. Further research is required in the area of developing procedures for systematically identifying and structuring JPMS as well as mathematically determining values for the standards.

Select Instructional Setting - TRADOC PAMPHLET 350-30 identifies five instructional settings to which tasks can be assigned:

1. Job Performance Aids (JPAs). (Even though a job performance aid is not technically instruction, it can serve to eliminate the need for training.)
2. Self-Teaching Exportable Packages (STEPS)

3. Formal On-The-Job Training
4. Installation Support Schools (ISS)
5. Resident Schools (RS)

There are guidelines for assigning tasks to specific settings and for conducting trade-offs based on requirements and resources.

The guidelines for individual training are not applicable to team training. The major reasons for this are individual aids such as JPAs and STEPs are inherently inadequate except for teaching individual team members skills since they are not designed to account for interactive tasks. The decision as to whether or not team training should be conducted in resident schools or at unit sites must be based on a different set of criteria. The major consideration for determining the site of team training includes facilities, impact on jobs, availability of personnel (supervisory and trainees), and availability of equipment. This decision process can be modeled with explicit criteria established for each decision point. The trade-offs that may be made regarding site selection depend on cost benefits analysis.

Develop Objectives - The development of learning objectives for individual training follows standard procedures. Objectives are written for each training task selected, and each terminal objective must specify actions, conditions, and standards. The training tasks and objectives are classified by the following four categories:

- a. Information
- b. Mental skills
- c. Physical skills
- d. Attitudes

There is no reason that the procedures for developing team learning objectives should differ greatly for those set forth in TRADOC PAMPHLET 350-30. However, Thurmond and Kribs (1977) state that the procedures for developing the team objectives were inadequate. There are two major problems encountered. First, the inputs to this step were inadequate. If each step of the model had been applicable, then the data base for the objective development would

have been complete. Second, there is a need to develop new categories for objectives. Foremost is the need for a communications category and guidelines for addressing knowledge of team roles and attitudes under existing categories.

Develop Test - Good test construction depends on a good data base as well as good techniques for item development. Both of these dimensions are addressed in the individual ISD model. Tests must accurately represent job performance measures and be constructed to meet the criteria established in learning and terminal objectives. In regard to team training, the prior sections point out the deficiencies in generating useful JPMs and objectives. Given that a team ISD model will contain procedures for developing good JPMs and objectives, there remains a need for guidelines for test development. There has been little research in the area of team assessment instruments and the variables measured therein. However, the development of the National Training Center should provide considerable advancement in team performance evaluation techniques.

Describe Entry Behavior - In TRADOC PAMPHLET 350-30, two principal classes of entry behaviors are identified:

1. Basic aptitude and ability, and
2. Acquired knowledge and skills.

It is recognized that very little can be done to change the basic aptitudes and ability of the entering trainee and therefore instructional material characteristics such as readability, formats, and comprehensibility must match up with the trainee profile. On the other hand, trainees' acquisition of knowledge and skills not only will vary, similarly to their basic aptitudes and abilities, but it will be dynamic, based on student capability and motivation.

Entry behavior descriptions are developed from two principal sources:

1. Administrative data
2. Testing

Team entry behavior descriptions should come from the same sources. Administrative data would provide a profile of individual team members, and it could be used to generate a team profile. The dimensions of the latter have not been defined, but consideration should be given to the time the team has worked together, prior operational experience, unit performance records, etc.

Testing should also be a primary source of the team entry behavior description. Both entry and pretest are desirable, but the entry test serving as a diagnostic is most important. A diagnostic entry test would provide information regarding the team's weaknesses in terms of specific tactical operations and the level of training where the team should begin. The diagnostic entry test procedure will be closely tied to the test construction procedures developed for the previous step.

Determine Scope and Sequence - The ISD process for determining instructional scope and sequence involves conducting a learning analysis and identifying relationships that exist between or among objectives. In team training, the scenario format precludes the presentations of a precise objectives hierarchy based upon characteristics and relationships of tasks.

However, in order to match the entry level and projected accumulative learning of the subjects with the variety of team interactions present in a continuum of tactical combat situations, it is necessary to develop a scope and sequence of scenario presentations. In essence, team training occurs at four levels. These levels are (1) individual training, (2) beginning team training, (3) integrated team training, and (4) emergent team training. The scope and sequence must reflect both the theoretical underpinning as well as the implementation of our team ISD model. Thus, each scenario within the training progression incorporates increasing complexity in regard to team member roles; information flows, decision and problem solving requirements; coordination activities; and tactical evolutions develop. The following paragraphs discuss each level of the scenario presentation:

Individual Training:

As stated in the above paragraph, it is assumed that a minimum level of individual competence must be achieved before team training can be effective and efficient. The interservice ISD Model provides the methods for developing the individual training.

Beginning Team Training:

The second sequence of scenarios should be in the beginning team lesson. This type of lesson should introduce the subjects, for the first time, to coordinated sequence drills. In addition, problem complexity should be increased by number of missions, amount and complexity of tactical information and amount and complexity of team problem solving activities. The beginning team training essentially is doctrine training, focusing on the established team roles.

Integrated Team Training:

The third level of scenarios should represent integrated team training. Integrated team training is designed to incorporate instructional strategies which are related to coordination and compensatory member's interactions. The team members should be presented with multiple tasks which are to be integrated through specific decision processing regarding the allocation of team resources. This instructional sequence should represent the multiple mission and task operations which characterize actual operations. Thus, the team will have to demonstrate both individual and team coordinated (compensatory) behaviors through the lesson. The decision base should be dynamic, primarily based on individual performances and mission-task priorities. The operational conditions for the integrated team training scenario (e.g., equipment, personnel, logistics, etc.) should be presented in a favorable tactical evolution.

Emergent Team Training:

The final sequence of scenarios is for emergent team training. These scenarios should be designed to incorporate all instructional strategies previously employed - specifically emphasizing those of major complexity within the integrated team training scenarios. Further, the instruction should incorporate operational fluctuations (positive and negative) and operation catastrophes as identified in the job/task flow charts.

Specify Learning Events/Activities - TRADOC PAMPHLET 350-30 does not use the term "instructional strategies". However, this step involves activities that underlie the selection of an instructional strategy for individual training. The procedures consist of applying an algorithm for classifying learning objectives. The classifications of the learning to take place are associated with detailed learning guidelines. The guidelines are applicable to the teaching of individual team member skills and provide insight into specifying the use of knowledge of results, performance monitoring, and identifying key instructional decision points.

Team training instructional strategies have been defined similarly to individual strategies (Thurmond and Kribs, 1977; Hansen, 1970). By definition, instructional strategies are the product of a series of decisions which provide for structuring the training by such variables as media choice, content, pacing, level of difficulty, reading level, feedback, etc. These decisions are based upon three types of information: (1) the task to be learned, (2) the learner, and (3) the delivery system for instruction. As yet, there are no guidelines for integrating this information and making the required decisions. Sets of general learning guidelines could be developed. The basis for the guidelines should be the team task dimensions, the framework for determining instructional scope and sequence, and the existing interservice procedures for individual training.

Summary

The interservice procedures for instructional system development presented in TRADOC PAMPHLET 350-30 provides a well organized

framework for developing team ISD procedures. However, they are clearly insufficient without content modifications and enhancements to serve as the guidelines to team training materials development. The area where considerably more proceduralization is required is in the analysis phase. Team job/task analysis techniques must be developed. These techniques should yield task analytic data that represents team operations in standard operating situations and in emergent situations where task and environmental factors are unpredictable. Other steps that are deficient include the development of team job performance measures and the selection of the instructional setting. In both of these cases, existing procedures provide groundwork and a beginning point.

Another basis for developing a team ISD model is the findings of the extensive amount of research conducted on teams and team training. This data base has served as the primary underpinning of this study. Conceptual and empirical views of team operations and training will serve well as the framework for a team ISD model.

RELATIONSHIP OF SKILL & PERFORMANCE AIDS (SPA) TO COLLECTIVE TRAINING

This section summarizes the approach that the Army has developed so that training and technical documentation will be integrated and, hopefully, contribute to a more effective training program and an improved operational readiness state for soldiers and equipment. The thrust of the approach is to provide more usable and comprehensible technical manuals and to provide training that is job oriented. Thus, there is an emphasis on Extension Training Materials (ETMs) as well as school curricula.

A fundamental premise of the SPA approach is that the U.S. Army Training and Doctrine Command (TRADOC) will be a full partner in the acquisition of technical documentation. TRADOC assumes specific responsibility throughout the life cycle of an acquisition, ensuring that training considerations addressed in conjunction with the specification and development of other technical documentation. In the following subsections these responsibilities shall be discussed as they relate or may have a potential for

relating to collective training. Further, the developmental processes associated with TRADOC's training responsibilities shall be reviewed for their application to collective training. The major source documents for this section are:

- "DARCOM/TRADOC Policy Statement of Integrated Technical Documentation and Training (ITDT), "Department of the Army Headquarters, TRADOC, Fort Monroe, VA 23651, 31 January 1978.
- Integrated Technical Documentation and Training Preparation Guide, U.S. Army Communications Research and Development Command (CORADCOM), June 1978.
- Technical Documentation and Training Acquisition Handbook, U.S. Army DARCOM/TRADOC 2 May 1977 (Draft).

DARCOM C1 AMCP 750-16, DARCOM Guide to Logistic Support Analysis, "Appendix G: Development of Integrated Technical Documentation and Training Materials Utilizing Logistic Support Analysis," U.S. Army DARCOM Materiel Readiness Support Activity, Lexington, Kentucky, January 1978 (Draft).

Additionally, considerable information was obtained from Kenneth A. Polcyn's report: "U.S. Navy: Training Relationships, Responsibilities, and Problems and the Possible Implications for the Naval Technical Information Presentation System (NTIPS) Training Interface."

Training Responsibilities in the SPA Life Cycle Management Model (LCSMM)

As a point of reference, it should be noted that TRADOC does not have the sole responsibility for the funding of training materials. The funding responsibilities for SPA are delineated for both new and fielded systems. In the former case, DARCOM has the sole responsibility for new system funding to include front end analysis, technical documentation, and training materials required by New Equipment Training (NET) teams to introduce a system into operational units and TRADOC schools. TRADOC is to provide for any

additional training materials. Both DARCOM and TRADOC provide funds for the procurement of SPA for fielded systems or items.

What is relevant to this report is that there is a close, working interface between the Army Training and Materials Command and that specific training activities have been related to LCSMM basic events. A summary of that relationship:

Concept Generation - In regard to the concept generation phase, if SPA is to be applied, the responsibility for executing front-end training studies, etc., belongs to TRADOC. Therefore, from the beginning of the acquisition process the appropriate TRADOC school is directly involved. The specific responsibilities of TRADOC during this phase include:

- Determining an individual's role in the proposed system and identifying associated implications for training,
- Developing a training concept indicating, in general, when, where, and how training can be best accomplished,
- Identifying and specifying studies needed to validate the training concept,
- Developing an outline Individual/Collective Training Plan (ICTP) summarizing the training concept and associated strategies and development plan, and
- Preparing and providing inputs to the basic systems analysis, documentation and decision-making events, such as the Letter of Agreement (LOA), Concept Formulation Package (CFP), Outline Development Plan (ODP) and program initiation decision process.

Validation - During the validation phase TRADOC is responsible for six activities. Some are contracted while others are executed directly by TRADOC or in conjunction with DARCOM. The training-related activities include:

- Preparing the Technical Data Package to be used in soliciting, identifying, and selecting the appropriate contractor(s) for the conduct of the front-end analysis,
- Conducting the front-end analysis,
- Evaluating alternative training program designs,
- Specifying training device requirements,
- Preparing a detailed training plan, and
- Providing input and support to basic system events as required, which includes the planning and conduct of Development Testing (DT)/Operational Testing (OT) I; preparation of the Required Operational Capability (ROC) or Letter Requirements (LRs); and preparation of the Development Plan (DP).

Engineering Development - The primary training activities during this phase are developing training program materials in keeping with the approved design and validating the instructional program. The major TRADOC functions are monitoring and reviewing intermediate and final products and coordinating interfaces. Major activities include:

- Awarding the Training Development/Production contract
- Developing materials and devices
- Commencing NET
- Validating the program
- Providing input to the LCSMM basic events - the engineering development contract, the planning and conducting of DT/OT II, the DP update, and the production and deployment decisions.

Input to the DT/OT III includes training test participants with the training package and evaluating the results, using data from training activities to update the DP, and using data from cost-effectiveness studies and the other data points to derive system production/deployment decisions.

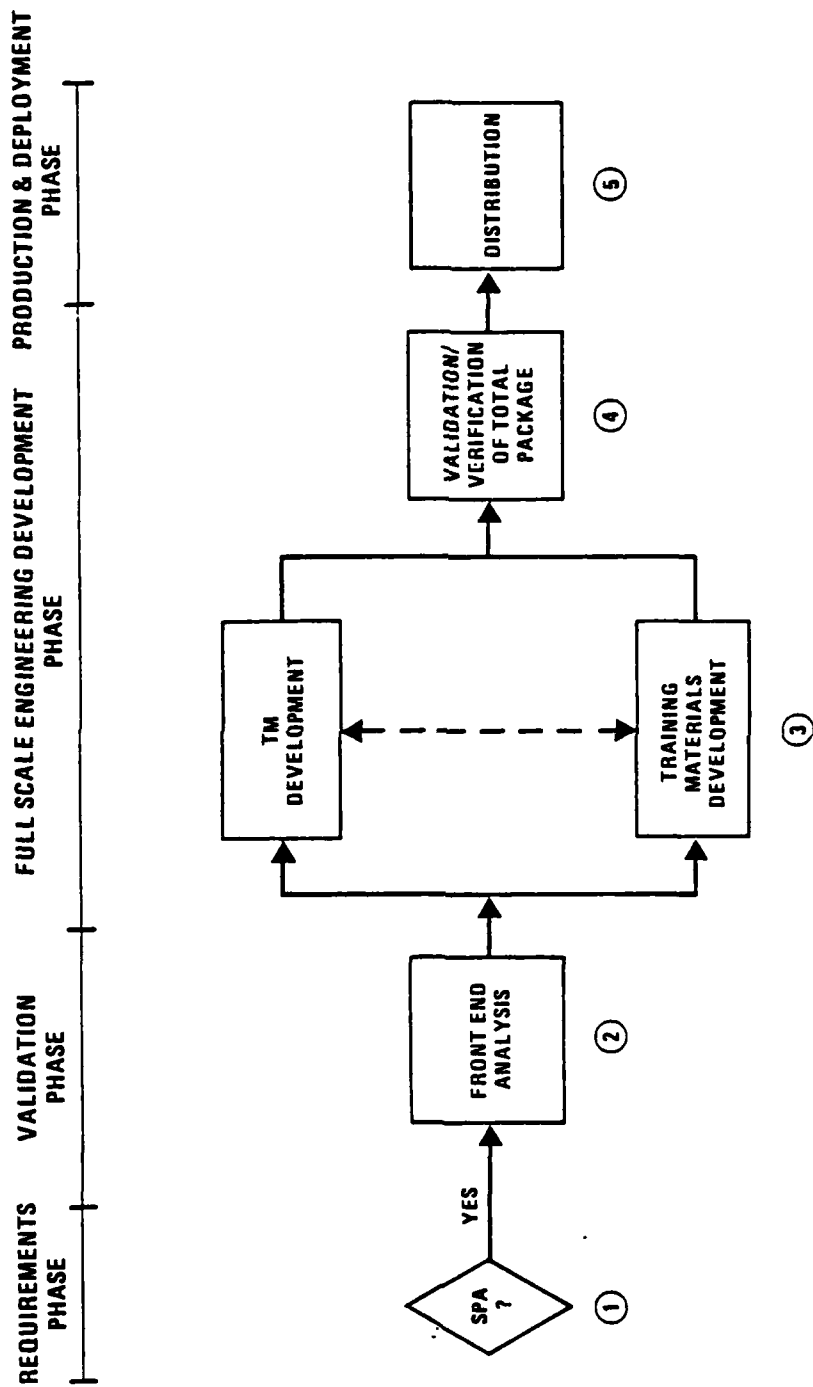
The Army also addresses the phase-out of the program and responsibilities of TRADOC throughout the deployed life of a system or item and throughout the life cycle of the training acquisition process. TRADOC is supposed to keep a systematic record of activities and costs for reference in future acquisition efforts. Emphasis is on summation of job and task performance requirements, data collection and analysis methods, training methods and media, cost-effectiveness information, and chronology of lessons learned. During program phase-out, TRADOC is supposed to update the data and assemble and store it in a central location for convenient reference.

Table 2 provides a summary of the relationship of training activities to basic events of the acquisition process.

In summary, these are the major TRADOC/DARCOM acquisition process interfaces that have been spelled out by the Army to ensure that SPA works. In addition to providing information on what needs to be done, the Army gives direction as to how the work can be accomplished.

A Summary of the Integrated Technical Documentation and Training Development Process

As illustrated in Figure 2, the SPA approach consists of five components which are embedded in the U.S. Army LCSMM. The first is deciding, during the Requirement Concept Phase, whether to apply the approach; if the decision is yes, then a Front End Analysis (FEA) is conducted during the Validation Phase. During the next phase, Full-Scale Engineering Development (FSED), the concurrent and interrelated development of TMs and Training materials occurs. The next step, verification, is initiated during the Engineering Development Phase and may or may not be concluded during the Production and Deployment Phase. It is in this phase that TM and Training materials are distributed. The FEA, TM and Training materials development processes are primarily the responsibility of a contractor, while the verification and acceptance functions are the responsibility of the U.S. Army. What is most important to this study is the process for conducting the FEA. However,



SOURCE: Integrated Technical Documentation & Training: Preparation Guide, U.S. Army CORADCOM, June 1978. Figure 1, p. 4.

Figure 2. SPA GENERAL DEVELOPMENT PROCESS

Table 2

GENERAL RELATIONSHIP OF TRAINING ACTIVITIES
TO LCSMM BASIC EVENTS

EVENT* =	LCSMM PHASES AND BASIC EVENTS	ASSOCIATED TRAINING ACTIVITIES
1 2 8 9 14	RQ'MT CONCEPT GENERATION Material Concept Investigation LOA CFP ODP Program Initiation Decision	<ul style="list-style-type: none"> • Materiel/Training Trade-off Analysis • Establish Training Concept • Identify Study Needs • Prepare Outline Training Plan • Inputs to LCSMM (LOA, CFP, etc.)
16 21-22 31 33 37/42	VALIDATION PHASE Advanced Development Contract DT/OT I ROC/LR DP Full-scale Development Decision	<ul style="list-style-type: none"> • Front-end Analysis and Design Contract • Perform Front-end Analysis • Evaluate Alternative Designs • Specify Training Device Requirements (TDR) • Prepare Training Plan • Inputs to LCSMM (ROC/LR, DP, etc.)
45 51-52 60 64/71	FULL-SCALE ENG'R DEVELOPMENT PHASE Engineering Development Contract DT/OT II Update DP Prod. and Deployment Decision	<ul style="list-style-type: none"> • Training Development/Production Contract • Develop Materials/Devices • Start New Equipment Training • Validate Program (OT II) • Inputs to LCSMM Basic Events
72 78-79 82 105 111 117 118 119	PRODUCTION AND DEPLOYMENT PHASE Production Contract DT/OT III (If Authorized) Update DP IOC Materiel Objective Achieved Req't. for New Materiel Identified Type Class Contingency Type Class Obsolete/Disposal	<ul style="list-style-type: none"> • Produce Training Materials/Devices • Field Test Program • Update Training Plan • Implement Program (Resident and Unit) • Evaluate/Revise Program • Inputs to LCSMM Basic Events • Phase-out

SOURCE: Technical Documentation and Training Acquisition Handbook, U.S. Army DARCOM/TRADOC 2 May 1977 (Draft)
Table 3-1, p. 3-14.

before discussing the FEA, a brief summary of each of the steps in the developmental process is presented.

SPA Approach Decision - The criteria which are used to determine whether the SPA will be used are listed following:

- Combat criticality
- Density
- Size of MOS population
- Training costs
- Commonality
- Foreign military sales potential
- Stage of life cycle
- Availability of funding to support program
- Delay caused to testing or field system.

If an item is highly critical for combat, its readiness to perform should be ensured through SPA. If it has a high density, requires a large number of people who would normally receive extensive school training, or is common to several systems, it is a prime candidate for the overall life cycle cost savings inherent in SPA. A high foreign military sales potential also increases the appropriateness of the item for SPA. The last three criteria may weigh against the approach. If an item is in an advanced stage of the life cycle, the cost of replacing existing technical documentation and training materials may outweigh the benefits of SPA coverage. Similarly, the limited availability of funds for low priority items may preclude their conversion to the approach. Moreover, the approach may be excluded if it would delay the fielding of a critical item.

Front-End Analysis - The FEA is based on a thorough LSA: these analyses may or may not be conducted by a contractor. The FEA has three stages:

- An equipment analysis to identify equipment tasks,

- A functional analysis to locate fault symptoms requiring troubleshooting and to describe mission functions and the operation of related equipment systems, and
- A task analysis to derive data to be used in technical documentation and training material development.

If under contract, each of the three products is reviewed and approved by DARCOM and TRADOC representatives before the contractor is permitted to proceed. These products are then used to create the technical documentation and training materials.

Technical Documentation Development - The Technical Documentation (TM) development is comprised of two separate sets of tasks. These are:

- A Behavior Task Analysis (BTA) which is conducted to correlate the behavioral objectives of each subtask with the cues that guide the associated response.
- The development of TMs which contain task performance sequences with detailed, illustrated step-by-step performance instructions.

Training Materials Development - The requirement that a concurrent and integrated development of training materials and TMs be executed dictates an internal contractor development relationship between TM and training personnel that has not been the norm in the past.

The training materials that can be developed under the SPA approach cover the known spectrum; they include printed, audio-visual and computer-based material. Basic training materials, which are developed to support courses for a specific job duty position, include lesson materials and instructions, tests and training guides. Among the materials are:

- Administrative instructions for training managers, criterion referenced pre- and post-lesson and module tests, and so on. The instruction sheets reference applicable TMs containing the content for training.

- Student Guides (SG) designed to enable trainees to plan and manage their own training.
- Training Management Guides (TMG) designed to enable the training manager or supervisor to administer using the ETM course materials.

Throughout the development of the materials, they are checked by Training personnel and reviewed to ensure compatibility with the TMs.

Training Materials and TM Verification - An important aspect of the SPA concept is that only a minimal number of training materials are prepared since TMs provide the major means for conveying procedures and related information for task performance; training materials are used as a supplement to TMs to teach the operation and maintenance of specified Army systems.

Verification of the total package involves validation of individual TM and training material products, or portions of products, by testing them on a sample of personnel representative of the target group. The real proof of usability and/or effectiveness for SPA materials is demonstrating that Army units can utilize new or unfamiliar equipment guided only by SPA documentation. Prior to delivery, the complete set of materials is verified, through testing by the government or contractor, and revised as needed. The final product is an integrated technical documentation and training package.

TM and Training Materials' Distribution, Update, and Revision - The TMs are reproduced and distributed through the Army Technical Publication Facilities, whereas the training materials are reproduced and distributed through the Training Extension Course (TEC) Program Facilities. Therefore, close coordination is required between the two for detecting deficiencies, providing for corrections, and incorporating updates and modified information.

Key SPA Guiding and Procedural Specifications, Standards, Directives, and Products

The development of the SPA approach was built upon existing DoD Directives and Military Standards. New guiding documentation

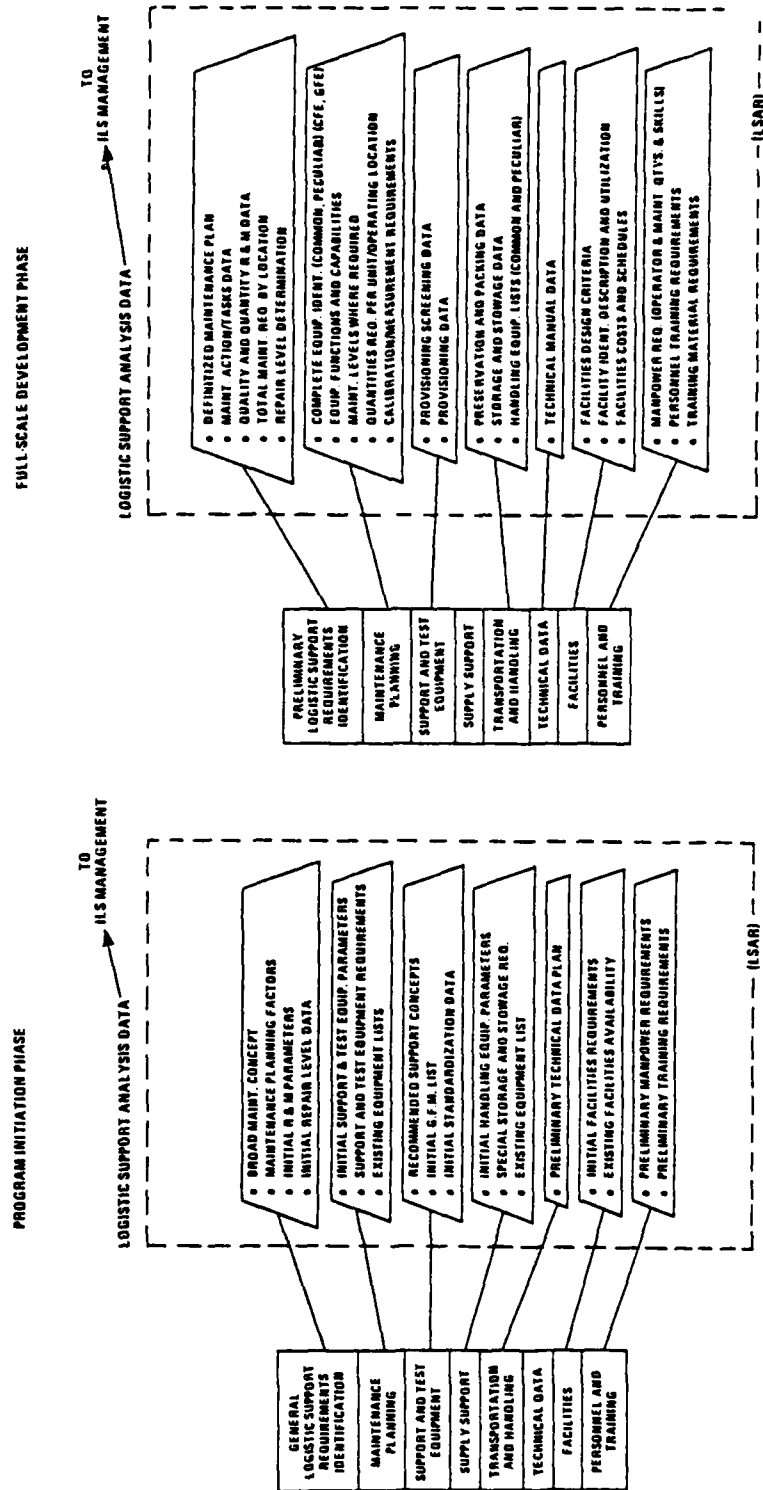
was developed only when necessary, but such documentation primarily deals with how to structure data normally collected during an LSA to meet the SPA objectives. Consequently, new guiding documentation has been held to a minimum. The key to the concept is the initial and continuing ILS data generation and collection effort.

Existing Documentation - The primary document upon which SPA is built is Military Standard Logistic Support Analysis 1388-1 (MIL-STD-1388-1), which establishes criteria governing performance of an LSA. The LSA flow and LSA requirement data identified in MIL-STD-1388 are used as a baseline and expanded so that SPA analyses, etc., can be conducted and the data structured for the ultimate development of integrated technical documentation and training materials.

Of the thirteen LSA tasks identified in MIL-STD-1388, the major contributors to technical documentation and training data requirements are the logistics requirements identification and engineering interfacing tasks. Logistic requirements identification tasks define the requirements of the principal elements of ILS. These are shown in Figure 3. Engineering interfacing plays an important role in that it supplies basic logistic data from the following engineering specialty areas and programs:

- System and Design Engineering
- Reliability Program (MIL-STD-785)
- Maintainability Program (MIL-STD-470)
- Human Engineering Program (MIL-H-46855)
- Standardization Program (Mil-STD-680)
- Safety Program (MIL-STD-882)
- Packing, Handling, Storage, and Transportability Program (MIL-STD-1367).

These, then, are the key components of the TI generation and data processing system upon which SPA is based.



SOURCE: Military Standard Logistic Support Analysis, MIL-STD-1388-1, DoD, 15 October 1973, p. 21.

Figure 3. LSA REQUIREMENTS DATA

New Documentation - Building on the above data base, the Army developed documentation which would permit an interface with LSA and the structuring of LSA data to meet the SPA objectives. There are seven such documents, six of which emphasize TM development, since TMs are the heart of the SPA concept. The SPA documentation includes:

- MIL-M-63035 (TM) Technical Manual Front End Analysis - Details the requirements and procedures for performing a system-specific job analysis prior to the development of TMs and training materials. It is the key SPA specification.
- MIL-M-63036 (TM) Preparation of Operator's Technical Manuals - Provides the detailed requirements for the preparation of Operator's TMs for all equipment except aircraft. This is also a basic SPA specification required of all projects.

There are three specifications which treat the development of maintenance TMs MIL-M-63037, MIL-M-63038 and MIL-M-63039.

- MIL-M-63037 (TM) Organization, Direct Support and General Support Maintenance Technical Manual - Specifies and details the use of flow charts for presenting maintenance information; e.g., troubleshooting procedures to be in the form of symptom-oriented branching and illustrated logic tree flow charts.
- MIL-M-63038 (TM) Organization, Direct Support and General Support Maintenance Technical Manual - Provides technical content and arrangement requirements for maintenance TMs. Associated style and format requirements and TM writing information are provided in two companion publications:
 - MIL-HDBK-63038-1 (Technical Manual Writing Handbook) and
 - MIL-HDBK-63038-2 (Technical Writing Style Guide).
- MIL-M-63039 (TM) Organization, Direct Support and General Support Maintenance Technical Manual - Provides detailed

requirements for the preparation of maintenance TMs in a Job Performance Manual (JPM) format. It specifies the use of functional block diagrams, rather than logic trees, for the presentation of troubleshooting information.

One specification treats training materials development. It is a basic document for all SPA projects.

- MIL-M-63040 Extension Training Materials - Contains detailed requirements for the preparation of EMs for use with SPA TMs.

Finally, there is a style and format specification which is not new.

- MIL-M-38784A, Technical Manual General Style and Format Requirements - Covers the general style and format requirements for the preparation of manuscripts and reproducible copy. Included are examples of typical formats, illustrations, etc.

These SPA documents, married with the basic LSA data and processing programs, provide the ingredients for structuring and producing the desired TMs and training materials.

Front End Analysis - As was mentioned previously, the FEA is comprised of an equipment functional analysis and task analyses. The Army has developed the SPA FEA requirements so that, in the main, they can be in accordance with MIL-STD-1388.

In conducting the equipment analysis, the Army maintains that the MIL-M-63035 (TM) needs can be met without any alteration to the normal range and depth of the LSA and that the deliverable products can be provided in accordance with the CDRL. Furthermore, much of the functional analysis data is collected as part of the System/Equipment Reliability Program established under MIL-STD-785, which provides the Failure Mode and Effects Analysis (FMEA) to the LSA process through LSA engineering interfacing. However, MIL-M-63035 (TM) does require that the analysis include functional block diagrams for separate maintenance levels. A task analysis is

required by MIL-STD-1388-1 in the System/Equipment Maintainability Program MIL-STD-470; this satisfies the task analysis specified in MIL-M-63035 (TM).

The behavioral task analysis is the pivotal point in the process because LSA data is massaged and structured for the development of the TMs and training materials. The guidance of MIL-M-63035 (TM) requires a tailoring of the output of the logistic requirements identification and engineering interfacing tasks. more specifically, the traditional identification of technical publication data is expanded to require more emphasis and detail for cues and responses associated with individual task steps. Furthermore, the engineering interface with the human engineering program (MIL-H-56853A) is expanded because it only calls for detailed human engineering task analysis and validation to be performed on those tasks: (1) requiring critical human performance; (2) reflecting unsafe practices; or (3) subject to promising improvements in operating efficiency.

In the main, the output of the LSA for SPA purposes can be accommodated with the standard LSAR data sheets and work summaries; however, sometimes SPA supplemental forms, work sheets or reports are required. Where LSAR is automated, applicable LSAR input sheet data and output summaries are identified for each LSA product. Where it is not automated, the required SPA products are developed manually.

SPA Front End Products - The SPA program requires the contractor to deliver LSAR data sheets, work summaries, etc., which was not previously the case. The reason for this change is that these products are key to the design, development and maintenance of TMs and training materials and they can be used to verify training concepts and contractor developed products, or to permit the Army to develop products as required. The following discussion provides a brief summary of the products with reference to the applicable LSARs.

Equipment Breakdown - The equipment breakdown is a list of all equipment items by equipment groups. It shows the next higher assembly relationships of all items on the list and includes

National Stock Numbers (NSNs), part numbers, Federal Supply Code for Manufacturers, and reference designators, if applicable.

Tool and Test Equipment List - This is a list of all tools and test equipment, both special and common, required to maintain the equipment. It contains a reference to the individual tasks listed on the Maintenance Allocation Chart (MAC) with which the tools are associated. Data displayed on the list include the name, NSM, and tool number for each item.

Maintenance Allocation Chart - The MAC identifies the maintenance tasks and the associated man-hours and maintenance levels for each reparable item in the equipment.

Block Diagrams - Block diagrams are used to document functional breakdowns for each maintenance level and to display all inputs and outputs depicting the inter-relationships associated with each functional group.

Functional Descriptions - Functional descriptions describe the purpose of each functional group defined on the block diagrams in the context of its interaction with interconnecting functional groups. They describe the inputs and outputs displayed on the block diagrams and are limited to those effects which are observable to the senses, either with or without test equipment.

Assembly Schematics - Assembly schematics are detailed diagrams in schematic format which provide source and destination information on each input and output for each reparable equipment assembly.

Detailed Assembly Schematic Descriptions - Detailed assembly schematic descriptions provide information on each assembly schematic.

Support Diagrams - Support diagrams include wiring diagrams, piping flow diagrams, and cabling diagrams which are required to supplement the block diagrams and assembly schematics to ensure that all equipment information required in the troubleshooting process is available.

Preliminary Task Development Worksheets - Preliminary task development worksheets are prepared for each task identified on the MAC. These data describe how each task is performed and what related logistic support elements are to perform it. These elements include tools and test equipment, expendable items, consumable items, and replacement parts.

Task List - The task list annotates those tasks which are selected for training and, using ETM, indicates which of the training tasks are suitable for formal classroom training and which are suitable for On-the-Job Training (OJT). The list also identifies performance standards required, the rationale for selecting the task, and the rationale for determining the recommended training location (classroom vs. OJT).

Behavioral Task Analysis Material - Behavioral task analysis material includes identification of behavioral objectives, cues, and responses for each task. Most of the cue information is documented in graphic form and integrated with response information in written form.

In conclusion, the marriage of existing LSA documentation with the SPA program has been fairly well established. While bridges were needed in some instances, in general, few major changes appear to have been required. Nevertheless, new requirements have been imposed upon the contractors that necessitated a reorientation in their thinking about ILS/LSA, TMs, and training materials. Three major changes have evolved: (1) the delivery of LSA products; (2) the working relationship between their TM and training personnel; and (3) the rigorous scrutiny entailed in the development of the SPA package.

The changes cited in the preceding paragraph are leading to improvements in the technical information used for system/equipment operations, maintenance, and individual training. The SPA and LSA documentation does not, however, provide guidance for specifying or developing collective training.

ASSESSMENT OF COLLECTIVE FRONT-END ANALYSIS PROCEDURES DEVELOPED FOR ARTEP

This section addresses the research question of the adequacy of the TRADOC PAMPHLET 310-8 (Draft) as a set of guidelines for collective training development. The section has two major parts. The Overview describes the RADOC approach. The Assessment discusses the major strength and weaknesses of the approach.

Overview

TRADOC PAMPHLET 310-8 (Draft), Collective Front-End Analysis (CFEA) for Development of Army Training and Evaluation Program (ARTEP), was developed as a guide to assist training developers perform ARTEP mission and task analysis. This document reflects an awareness on the part of TRADOC of the deficiency of proceduralization of collective training development. As its title indicates, the focus is on front-end analysis.

In order to provide a brief context of the CFEA, the following three definitions are provided:

1. Missions - Missions are major Table of Organization and Equipment (TOE) activities performed by recognized TOE echelons.
2. Collective tasks - A specific action or actions performed by two or more persons in the accomplishment of a unit mission. These actions, i.e., tasks, have identifiable starting and ending points and result in a measurable accomplishment or product. Tasks are also discrete and can be performed, if the conditions exist, independently of other tasks not involving the same personnel and equipment.
3. Collective front-end analysis (mission/task analysis) - The analysis process in which the TOE capability of the unit, the unit missions (stated and implied), the most current tactical doctrine and applicable threat doctrine available are systematically analyzed and

integrated to determine the critical missions and critical tasks of a unit. The critical missions/tasks are then developed into training and evaluation outlines and published in ARTEP documents.

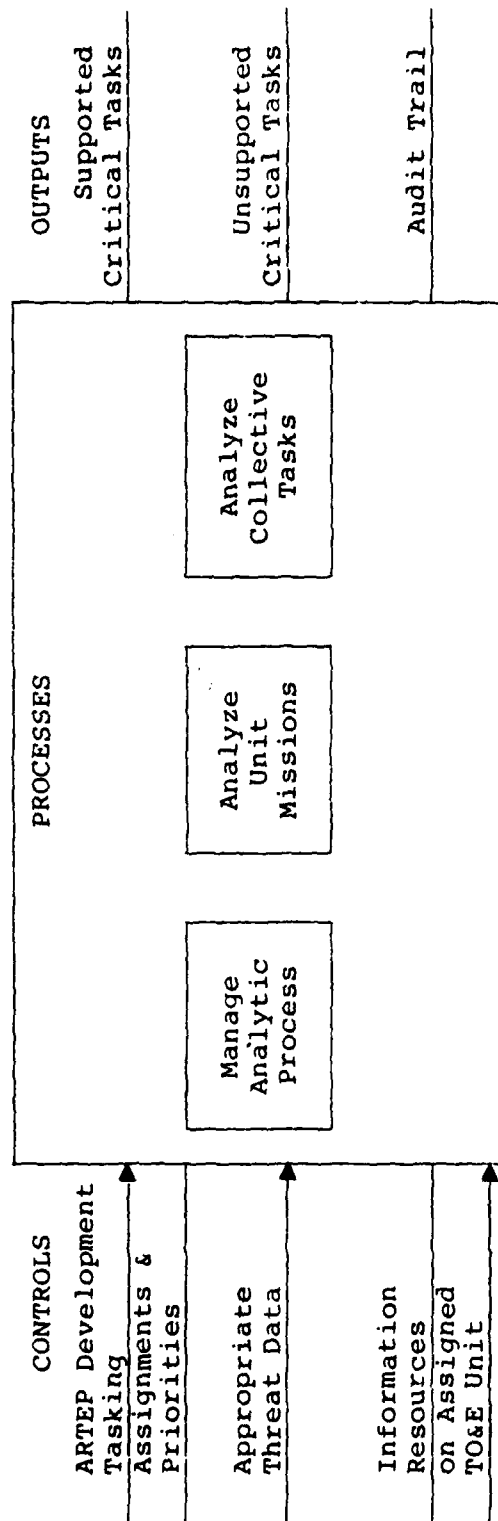
TRADOC PAMPHLET 310-8 (Draft) provides a model for the mission and task analysis processes. The model's purpose is to provide a path of actions for the analyst to follow in the development of an ARTEP. Figure 4 presents the model. The model may be described as follows:

1. The initial controls for the model are the taskings and priorities given to the analyst and the appropriate threat. Information resources are the only input to the diagram.
2. The manage analytic process function changes the information resources into the reference material used by the other two functions. The manage function also prepares material for the audit file.
3. The analyze unit missions function analyzes the TOE and the threat. This results in an echelon-mission-situation combination.
4. The analyze collective tasks function develops a task list, then evaluates the criticality and supportability of the tasks. Model outputs are the supported and unsupported critical task lists and the audit file. The file also receives the list of noncritical tasks.

The following sections provide a more detailed description of the three major model functions of (1) manage analytic processes, (2) analyze unit mission, and (3) analyze collective tasks. For each function a brief discussion of the strengths and weaknesses of the underlying procedures is included.

Manage Analytic Process

Managing the process breaks down into assembling references, obtaining advice on review board decisions, developing criticality



Adapted from Figure 2-5 Conduct Front-End Analysis, TRADOC PAMPHLET 310-8 (Draft).

Figure 4. Collective Front End Analysis Model

criteria and preparing the audit file. The management process begins by assembling reference material from information resources. This is done under the control of ARTEP development tasking.

A review board and subject matter experts (SMEs) are selected from an expert list who review material on request producing advice or board decisions. Criticality criteria and judgment procedures are produced under the guidance of ARTEP tasking and board decisions. Previous criticality studies, if any, are used by this function.

An audit trail is recorded in an audit file. It contains a description of all the other functions in the model along with all decisions made and their justification.

The pamphlet continues to break down each of the subfunctions described above into specific processes for accomplishing the objectives of the function.

Analyze Unit Mission

Unit missions are analyzed by identifying the echelon contained in the unit, developing situations each echelon may encounter, and then identifying missions each echelon would perform in the situations. ARTEP tasking guides the identification of echelons in the TOE. The unit and echelon list is used with doctrine, terrain and weather in the development of situations according to the tasking and the threat. The situations and the unit echelon list guide the identification of missions from the TOE, doctrine, unit histories, SME advice and board decisions. This results in echelon-mission-situation combinations. The board review is requested when the combinations are ready for review.

Analyze Collective Tasks

For this function the TRADOC PAMPHLET 310-8 (Draft) model directs the training developer in the decomposition of the mission-situation combinations into tasks. The tasks are subjected to a criticality rating and subsequently reviewed by the board. Conditions (primarily the situation parameters) and standards are to provide the basis for training objectives. Then the supportability

of each task is determined. Supportability depends upon (1) the adequacy of the task design in terms of meeting the mission, (2) and assessment of the capability of the echelon to perform the task, and (3) the existence of individual tasks, conditions, and standards that support the collective task. The latter is the result of the development of an individual/collective task matrix. There are seven sample forms for documenting the analysis of collective tasks. These include (1) a task analysis form, (2) a criticality form, and (3) an individual/collective task matrix.

Assessment

The TRADOC CFEA model incorporates a number of data sources which are critical to the development of a collective job/task data base. Foremost among these are the doctrine and threat data that to a large degree define the situational contexts for the team or unit's operations. From this data an operating continuum - ranging from the established standard operating procedures to emergent situations contingent on threat interactions - can be developed.

The CFEA model also incorporates another developmental feature that appears to be critical to the development of collective training. The individual tasks required to support a collective task are identified. Figure 5 presents a sample individual/collective task matrix. Within the context of missions, collective tasks, and individual tasks, families of collective tasks and task hierarchies are constructed. Assuming that appropriate and realistic standards are applied to the collective and individual tasks, this top-down analytical approach should result in a clear picture of mission-task relationships and, then, provide a sound basis for developing collective training strategies and actual training scenarios. There are, however, a number of shortfalls in the process.

According to the users of the CFEA model, the biggest problem that they encounter is the fact that the model "tells us a lot of things that we are supposed to do but doesn't tell us much about how to do them." It is clear that criticism is

		(INDIVIDUAL JOB)									
MECHANIZED INFANTRY RIFLE SQUAD	MISSION/COLLECTIVE TASK	A. Movement to Contact	Enforce noise/light disc SL-2	X				X			
		B. Reconnaissance Patrol	Identify threat vehicle/weapons	X	X			X			
			Conduct surveillance	X		X		X	X		
		C. Forced March/Live Fire Exercise	Collect/report info (SALUTE)	X	X			X			
			Process enemy personnel								
			Use challenge/password				X	X			
					</						

justified. Many of the guidelines are insufficiently detailed, and although there are some forms that support the process, these are inadequate. For example, the collective/individual task matrix presented in Figure 5 only list the individual tasks that are associated with a collective task. The nature and degree of relationship is not addressed. Task criticality, frequency, impact of inadequate performance, probability of failure, etc., are not determined as missions change.

A similar criticism of the model was leveled at the mission analysis function. First, directions for performing the analysis are not a step-by-step guide. Second, the product of this analysis is not well defined. Third, the model does not provide for a ranking of the mission or the identification of critical or capstone missions. In regard to the latter, the identification of familiar or strands of collective tasks that cut across echelons is dependent on relating missions and particularly capstone missions.

From the standpoint of this investigator, a fourth critical fault of the model is that it does not force the analyst to identify operating degradations and failures which impact task accomplishment. This should be done for both human and machine operations. Without this information it is impossible to get a clear picture of the collective training requirements.

SUMMARY OF INTERVIEWS WITH U.S. ARMY TRAINING DEVELOPERS

As stated in the Methodology section, a part of the project design included interviewing 12 training developers from the U.S. Army Field Artillery School (USAFAS), Ft. Sill, Oklahoma. The purposes of the interviews were (1) to define collective training development priorities, (2) to identify critical problems in collective training development for which team ISD guidelines might provide a solution, and (3) to collect inputs from training development that would be useful to the design and development of collective training procedures.

Appendix A contains an outline of the interview scenario as initially conceived. As can be seen in Appendix A, a basic

assumption of the approach was that there was formal collective training being conducted at USAFAS and that some systematic developmental process was in effect. This was not the case. The preponderance of the interviewees were associated with the individual training programs. However, representatives from the Army Training and Evaluation Program (ARTEP) office were interviewed. The ARTEP document is a listing of the critical tasks that a unit, battalion through gun section, will have to perform during combat. It was in fact these ARTEP representatives at the Ft. Sill office who identified the CFEA documentation, ARMY PAMPHLET 310-8 (Draft), as the only guidelines that they had as support. The ARTEP is the heart of non-resident training and as such links individual training with collective training at the unit's site (as part of the ARTEP) as well as linking the unit level collective training to more elaborate forms of collective training like that to be conducted at the National Training Center. As noted in the prior section, the ARTEP development concludes with the determination of critical combat tasks, along with associated conditions and standards. It does not provide specific guidelines for training personnel to perform the combat tasks.

Because of the large number of individual training developers and the limits of the ARTEP personnel development tasks, the proposed interview scenario was not applicable. Therefore, it was decided to make the interviews less structured, allowing the interviewees to discuss broader issues than originally intended and to bring out their perceptions of the range of issues associated with collective training development. While a large number of items were discussed, from the analysis of the interview tapes, it was clear that the preponderance of the responder's comments fell into the following categories:

1. Status of TACFIRE Team Training
2. Need for Guidelines for Collective Training Development.
3. Need for Specifications and Standards for Contractor Participation in Collective Training Development.

4. Need to Get USAFAS Personnel Involved in the Collective Training Acquisition Process.

Each of the issues are discussed in the following subsections. Where applicable, quotes from the interviews are incorporated.

Status of TACFIRE Team Training

While there was some divergence of views of TACFIRE team training, the variance was only in regard to how little team training is formally conducted. The following quotes are typical:

"We don't have team training today. We got a little exercise that involves more than one person but it is to evaluate operators - individual operators."

"No, we don't really attempt to train them together. The CPX is training, but it's probably more a test."

"The team training is a tape where the individual sits at the trainer and it looks like there are other people there. The tape - computer - simulates the operator's actions."

The USAFAS training developers did express a need for more collective training. Additionally, they identified problems that would be encountered in a significant upgrade of the collective training. The problems, pointed out in the following quotes, include (1) lack of talent to use the computer although the trainer is a major response, (2) lack of direction in the training, and (3) lack of time.

"Well, we should be doing more team training here at the school, but our way involves using the computer. So we have to train someone to use the computer language. That means we have to have someone trained in PLANIT for the individual training and someone trained in the team language, whatever it's called, for the team training. Also, scenarios are really just event sequences that go faster or slower on different memories. We don't try to represent Afghanistan,

Europe, South Africa or special conditions. We also don't really represent an enemy or opposing force. We need to make these scenarios better."

"I don't think that there's anything that gives us any tips or direction on how to prepare a scenario that would train better. A lot of the time we don't know just what we should be training. The ARTEP may tell us more about that."

"We've never really looked at doing cross-training or any thing that might lead to better crew performance other than to try to improve performance of the individual operators. It seems like we don't have enough time to do that."

Need for Guidelines for Collective Training Development

"310-8 [TRADOC PAMPHLET on Collective Front-End Analysis] is the definitive guide to front-end analysis - well I mean by definitive that it's the only thing we have."

This quote from an ARTEP representative at Ft. Sill summed up the responses to an inquiry regarding the need for guidelines for collective training development. The shortcomings of PAMPHLET 310-8 were discussed but it is worth noting that the major drawback and criticism of the model was that although it contained no less than 46 direct steps none were defined in great detail. Further the model only addressed CFEA and was not a guide to the design or development of training.

Another analysis problem is associated with the model, but certainly is not inherent to it. That is, the doctrine that is analyzed is frequently inconsistent or insufficient.

"There's not always consistency down through the echelons. In developing task hierarchies and families, some capstone missions did not track from battalion to gun crew, some were not supportable just because of doctrine."

In regards to the lack of doctrine in some areas, the following quotes clearly describe the situation:

"A lot of money is spent writing documents for the field artillery battery, 6-50. We write handbooks for the executive officer, handbooks for the battery commanders, we write documents for the fire direction center - right within the battery. But what do we do with headquarters battery. Without headquarters battery, without service battery, a firing battery would last in combat probably half a day. We never write any doctrine for headquarters battery."

"What does the battalion do? The command and staff, the operations, the S-4, and supply and all of those things that are going to interact on us in combat - what do they do for a living to support us?"

The lack of doctrine covering an operation or functional grouping is not the fault of the model. In fact it points out a strength of the model in that it reveals discrepancies in the system. But a consideration of a comprehensive collective training model must be how to handle doctrine gaps, inconsistencies, or other discrepancies.

Another problem, and a very critical one, emerged from responses to the question of what is an ARTEP and how is it used. The ARTEP is "listing of the critical tasks that a battery and battalion will have to perform in combat." An ARTEP should point out, for example, the multiperson tasks that "a gun chief knows his crew has to do - emplace a cannon, lay a cannon, perform a prefire check, fire the howitzer." Unfortunately the ARTEP "has been bastardized into a test." It is frequently stated that the ARTEP is a measure of reactions, not a training tool.

It was noted that the

"major reason that the ARTEP has become a readiness test is that nobody knows how to use them and the way they are set up they do look like test objectives or like the answer sheet."

"I used the ARTEP to develop a training scenario; a motor pool exercise. I gave them the general threat condition which would initialize the system, described the Op force, doctrine, initialization data, support requirements - personnel and equipment to support training, training and evaluation standards, and tips to trainers and evaluators. They were good exercises, but most of these guys don't know how to use the ARTEP."

Need for Specifications for Contractor Developed Collective Training Materials

"Existing specifications are widget oriented and are more concerned with getting manuals and individual maintenance [training]. We get no, absolute no, collective training data from the contractor."

In response to the question of "how could contractors support collective training development" there was some disagreement as to what specifically was needed from the contractor. But there was unison in the confirmation of the need. Some quotes discussing what the contractor could do are as follows:

"We need a list of collective tasks that are equipment peculiar."

"I need times - conditions and standards for the operating system."

"The contractor could also do a lot of the cross-match between the individual and collective tasks."

"Platoon leaders, I believe, are responsible for training their teams and they should be. They should write the scenarios, not contractors, because they know how their unit's operating characteristics better than anyone else. But they don't have time for it and they don't have guidelines for developing scenarios."

"Also the entire FEA documentation should be delivered because of the large number of models that we get."

Asking why contractor support is necessary did not yield any surprises but the major response is worth noting.

"Resources, one of the problems resources, we have over 22 courses being taught. We can't do all the things that we would like to because we don't have the bodies, dollars, whatever. Every time we have to do a new task or rewrite, revise a contractor's job, like redoing a TA, we have to take it out of hide using people that are already doing important jobs. Every [body] in the Army has the same problem and we know that we won't ever have, and probably don't deserve, all the money and people we would like. But we should be able to get more usable products from the contractors."

A final issue that was discussed was how to get the contractor to deliver useful collective training data.

"We got to have a set of guidelines for the contractor just like we have - or need - it should be the same set."

Although there was not much discussion of the specific content of the specifications, some important concerns for both contractors and government were raised:

"One of the problems, I feel, is that too much of this LSA, task analysis and so on is not understood by the contractor. They don't know what we need for training. And we don't know sometimes. When we started getting lessons in, we didn't like them. So we had to start changing them. Which cost us, the people here a lot of money to have to, you know, redo that stuff. It cost us a bunch. We really didn't know what to expect but we have a hell of a lot more experience. Both of us [the contractor and school personnel] need better specs on training ourselves."

"A set of specifications to be used by the contractor should also have the tools in it to make the contractor comply with the SOW and be sure that the deliverables are what we want. PRs, OA standards, and such should be referenced in the contract."

Need to Get Collective Training Personnel
Involved in the Acquisition Process

Another consideration associated with the procurement of contractor developed collective training materials is how to specify what is required. The response was to get the collective training developer involved in the process early. The SPA approach, as pointed out in a prior section, is based on a marriage between TRADOC and DARCOM. It was pointed out that on at least one occasion this occurred. We requested:

"A list of Pershing II equipment related collective tasks developed in accordance with TRADOC PAMPHLET 310-8 (Draft) CFEA, paragraph 1-3-D, will be provided."

"Normally we do not get to make these inputs. We have no license to get involved, but we need to get on board early as training planners and be involved throughout the early phases of the life cycle. We then could have a draft ARTEP and team training ready for OT II. We could check our conditions and standards in the ARTEP, and we could have given the test team training."

A point made earlier was then reiterated:

"Getting into the cycle is only a part of it. We still must get good materials - tasks lists and instruction, if delivered - from the contractors. And I'm not sure they know how to develop the things we need."

CONCLUSIONS

The conclusions sections addresses the fifth research question posited in the Introduction: What aspects of collective training analysis, design, and development continue to present problems to the collective training developer? When this question was first raised, it was assumed that significant amounts of collective training were being conducted at the artillery school at Fort Sill. It was further anticipated that by examining these collective training efforts and by interviewing the training developers, specific problems encountered during collective training ISD could be clearly identified. As indicated in the preceding sections, there was only a minimal amount of training, that could be construed as collective training, being conducted. Instead of being able to define specific problems, two general conclusions were drawn: (1) there is a need for a full set of detailed collective training guidelines, and (2) there is a need for contractor support for collective training, especially for analysis tasks.

In regard to the first general conclusion, the usability of the individual ISD model's procedures for collective training development was investigated. It was found that the application would be, at best, a force fit. The model does lend itself to be used as guidelines for the categorization and organization of ISD activities. The Interservice ISD model is a good representation of the many activities that go into establishing good individual training. However, the specific procedures in the ISD model will not lead to effective collective training.

In regard to the conclusion that collective training should become a contractor concern as well as being addressed within in-house developmental programs, there remains a problem of the lack of specifications and guidelines. Not only, then, must the collective ISD procedures be definitive enough to be used by trained Army personnel, but also they must be precise enough to ensure that the products delivered by various contractors meet the required standards. Concomitant to acquiring collective training data (from CFEA results to instruction) is the involvement of collective

training developers in the acquisition process as TRADOC representations. Further, if effective collective training is to be a contract deliverable, there needs to be a collective training focus at IPRs and validation activities.

In addition to examining the ISD model for applicability for collective training development, two other sets of procedures were reviewed: (1) the ARTEP CFEA procedures set forth by TRADOC, and (2) the procedures underlying the development of Skill Performance Aids (SPA). The CFEA guidelines are broken down into a large number of 'steps,' but the steps are not well-defined. Interviews with ARTEP personnel indicates that the CFEA guidelines need considerably more detail, more forms and structured worksheets to support the analysis activities, and more examples illustrating the products.

The SPA development procedures are dependent upon LSA for front end analysis. The investigation of the SPA and LSA documentation revealed that neither was designed to address collective training development.

RECOMMENDATIONS

1. Investigate the modification of LSA to incorporate the following features:
 - a. Provide a more usable format and collection of individual maintenance task data.
 - b. Provide for the identification of operator tasks along with associated skills and knowledges.
 - c. Identify equipment peculiar collective training tasks.
2. Improve TRADOC PAMPHLET 310-8 by more precisely defining the 46 identified processes and by developing additional support documentation.
3. Develop a trainer's guide to support ARTEP objectives. The basic feature of such a guide or handbook would be as follows:
 - a. Training Scenario Development
 - b. Sequencing Training
 - c. Training Tips (motivation, organization, instruction)
 - d. Observation and Evaluation Techniques
 - e. How to Use Knowledge of Results and Feedback
4. Develop a counterpart of the trainer's guide for the training developer's responsibilities beyond the CFEA, with particular focus on design and development activities. The Interservice Procedures should serve as an organization and context guide. New procedures, resulting in sound collective training materials, need to be developed.
5. The four previous recommendations should be augmented with a Contractor-Developed Collective Training Military Standard which contains all guidelines, standards of performance, Data Item Descriptions, and a QA program that is equally as intensive and demanding as the program associated with the acquisition of training under the Skills Performance Aids concept.

REFERENCES

- Alexander, L.T., & Cooperband, A.S. System training and research in team behavior (Tech Memo: TM-2581). Santa Monica, California: System Development Corporation, August 1965.
- Boguslaw, R., & Porter, E.H. Team functions and training. In R.M. Gagne (Ed.), Psychological principles in system development. New York: Holt, Rinehart and Winston, 1962.
- Briggs, G.E., & Johnston, W.A. Team training (Final Report: NAVTRADEVCEEN 1327-4). Orlando, Florida: Naval Training Device Center, June 1964.
- Folley, J.D., Jr. Guidelines for task analysis (Contract N61339-1218). Port Washington, New York: Naval Training Device Center, June 1964.
- Glanzer, M. Experimental study of team training and team functioning. In R. Glaser (Ed.), Training research and education. University of Pittsburgh, September 1961.
- Klaus, D.J. & Glaser, R. Increasing team proficiency through training: final summary report (Contract Nonr-2551(00), NR-154-079. Washington, D.C.: Office of Naval Research, Psychological Services Division Personnel and Training Branch, 1968.
- Klaus, J., and Glaser, R. Increasing team proficiency through training: a program of research (Technical Report AIR 264-60-TR-137). American Institutes for Research, December 1960.
- System Development Corporation. Utilization of tactical computers for training: final report (TM!5544/003/00). Santa Monica, California. May, 1976.
- Thurmond, P., and Kribs, H.D. Computerized Collective Training for Teams: Final Report. U.S. Army Research Institute and the Defense Advanced Projects Agency. Sensors, Data, Decisions, Inc., August 1977.
- Wagner, H., Hibbits, N., Rosenblatt, R. & Schulz, R. Team training and evaluation strategies: A state-of-art review (SR-ED-87-11, Contract No. MOA 903-76=C-0210). Alexandria, Virginia: Human Resources Research Organization, 1976.

APPENDIX A

INTERVIEW SCENARIO

INTERVIEW SCENARIO

Time Minutes	Activity
0-3	Collect biographical data State purpose of the interview
4-10	Describe interviewee ISD background What type of training How much training Describe training How much experience What type of experience Analysis Design Development Describe in detail ISD task performed Describe types of documentation prepared
11-30	Describe TACFIRE materials production techniques Analysis Task Analysis (TA) What materials are used in TA Are interviews used. Surveys. Describe. How Much do SMEs contribute How are the following identified and defined Communication tasks Attitude requirements General knowledge of team roles Construct Performance Measures How are proficiencies established Are team member interaction errors identified What criticality criteria are employed Are compensatory behaviors identified Design Develop Objectives Are team objectives developed

INTERVIEW SCENARIO (Cont'd)

Time Minutes	Activity
11-30 Cont'd	<p>Design (Cont'd)</p> <p>Do ISD objectives classification schemes lend themselves to developing team objectives</p> <p>Describe Entry Behavior</p> <p>Techniques used</p> <p>Variables considered</p> <p>Are team characteristics considered</p> <p>Determine Scope and Sequence</p> <p>Are hierarchical schemes used</p> <p>Are team learning tasks sequenced</p> <p>How are scenarios constructed</p> <p>Development</p> <p>How are instructional strategies developed</p> <p>How is media selected</p> <p>Are instructional management plans developed</p>
41-65	<p>Review and Analysis of Proposed Team Training Procedures</p> <p>Each section will be reviewed and analyzed</p> <p>Interviewee will be asked to judge the adequacy, feasibility, and labor-intensity of each step</p>
66-75	<p>Recommendations (Summary)</p> <p>Final recommendations to each section will be refined</p>

